



*A Field Guide to the Reptiles of South-East Asia* is the only comprehensive guide to this reptile-rich region.

- Nearly 700 species – many never illustrated before – captured in 74 specially commissioned full-colour plates by top wildlife artists.
- More than 1,000 species and subspecies described in thorough detail in authoritative, up-to-date text covering identification, habitat, behaviour, subspecies, distribution and status.
- Covers all the reptiles recorded for mainland South-East Asia and the islands of the Great Sundas.
- Explains how reptiles are classified, how to measure a reptile, how the scales of snakes and lizards, and the plastrons and carapaces of turtles, tortoises and terrapins, are used in identification.



NATURAL HISTORY

ISBN 978-1-54773-347-4



9 781847 733474

[www.newhollandpublishers.com](http://www.newhollandpublishers.com)

# REPTILES OF SOUTH-EAST ASIA

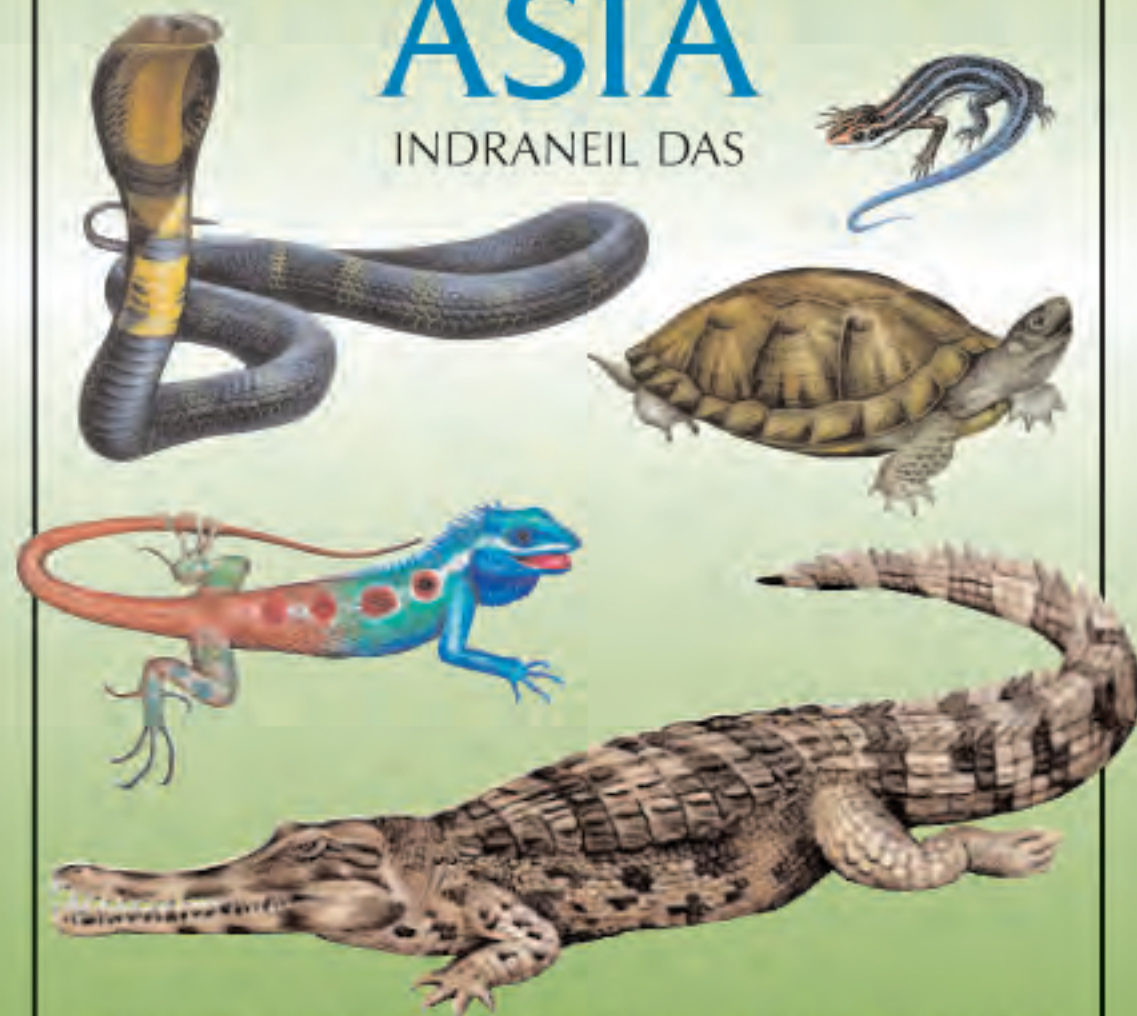
A FIELD GUIDE TO THE  
INDRANEIL DAS



A FIELD GUIDE TO THE

# REPTILES OF SOUTH-EAST ASIA

INDRANEIL DAS



MYANMAR, THAILAND, LAOS, CAMBODIA, VIETNAM, PENINSULAR MALAYSIA, SINGAPORE, SUMATRA, BORNEO, JAVA, BALI

A FIELD GUIDE TO THE  
**REPTILES OF  
SOUTH-EAST  
ASIA**

A FIELD GUIDE TO THE  
**REPTILES OF  
SOUTH-EAST  
ASIA**

INDRANEIL DAS

MYANMAR, THAILAND, LAOS, CAMBODIA,  
VIETNAM, PENINSULAR MALAYSIA, SINGAPORE,  
SUMATRA, BORNEO, JAVA, BALI

Illustrated by Robin Budden, Sandra Doyle, Rachel Ivanyi, Szabolcs Kokay,  
Jonathan Latimer, Denys Ovenden, Lyn Wells





First published in 2010 by New Holland Publishers (UK) Ltd  
This impression published in 2010 by New Holland Publishers (UK) Ltd  
London, Cape Town, Sydney, Auckland

www.newhollandpublishers.com

Garfield House, 86–88 Edgware Road, London W2 2EA, United Kingdom  
80 McKenzie Street, Cape Town 8001, South Africa  
Unit 1, 66 Gibbes Street, Chatswood, New South Wales, Australia 2067  
218 Lake Road, Northcote, Auckland, New Zealand

10 9 8 7 6 5 4 3 2 1

Copyright © 2010 New Holland Publishers (UK) Ltd  
Copyright © 2010 in text Indraneil Das

Plate illustrations by:  
**Robin Budden** 1–5, 10–14, 38–40  
**Sandra Doyle** 49–58  
**Rachel Ivanyi** 28–37  
**Szabolcs Kokay** 41–48, 72–74  
**Jonathan Latimer** 59–70  
**Denys Ovenden** 6–9, 71  
**Lyn Wells** 15–27

Copyright © 2010 in plates and drawings New Holland Publishers (UK) Ltd

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the publishers and copyright holders.

ISBN 978 1 84773 347 4

Senior Editor: Krystyna Mayer  
Design: Alan Marshall  
Cartography/Diagrams pages 8, 9 (top): Stephen Dew  
Indexer: David McAllister  
Production: Melanie Dowland  
Publisher: Simon Papps  
Editorial Direction: Rosemary Wilkinson

Reproduction by Modern Age Repro Co. Ltd, Hong Kong  
Printed and bound in Singapore by Tien Wah Press (Pte) Ltd

# CONTENTS

<b>Acknowledgements</b>	<b>6</b>	<b>Anguidae</b> Glass Lizards	195
<b>Abbreviations, Conventions and Symbols</b>		<b>Dibamidae</b> Worm Lizards	196
<b>Introduction</b>	<b>6</b>	<b>Eublepharidae</b> Eyelid Geckos	198
Defining Reptiles	<b>7</b>	<b>Gekkonidae</b> Geckos	199
Morphological Specializations	<b>7</b>	<b>Lacertidae</b> ‘Typical’ Lizards	225
Identification of Reptiles	<b>7</b>	<b>Lanthanotidae</b> Earless Monitor	226
Reptile Ecology	<b>8</b>	<b>Leiolepidae</b> Butterfly Lizards	226
Region Covered	<b>11</b>	<b>Scincidae</b> Skinks	228
The Environment	<b>13</b>	<b>Shinisauridae</b> Crocodile Lizards	254
Reptile Conservation	<b>15</b>	<b>Varanidae</b> Monitor Lizards	255
Book Organization	<b>15</b>	<b>SNAKES</b>	<b>256</b>
Management of Snakebite	<b>16</b>	<b>Acrochordidae</b> Wart Snakes	256
		<b>Anomochilidae</b> Giant Blind Snakes	257
<b>PLATES</b>	<b>18</b>	<b>Pythonidae</b> Pythons	257
		<b>Colubridae</b> ‘Typical’ Snakes	259
<b>SPECIES ACCOUNTS</b>	<b>166</b>	<b>Viperidae</b> Vipers & Pit Vipers	302
		<b>Cylindrophiiidae</b> Pipe Snakes	312
<b>CROCODILES</b>	<b>166</b>	<b>Elapidae</b> Cobras, Kraits, Coral Snakes	
<b>Crocodylidae</b> Crocodiles	166	& Sea Snakes	313
<b>Gavialidae</b> Gharials	167	<b>Homalopsidae</b> Puff-faced Water Snakes	324
<b>TURTLES</b>	<b>167</b>	<b>Natricidae</b> Water Snakes	330
<b>Geoemydidae</b> Asian Hardshelled Turtles	167	<b>Pareatidae</b> Slug-eating Snakes	344
<b>Cheloniidae</b> Sea Turtles	173	<b>Pseudoxenodontidae</b> False Cobras	346
<b>Dermochelyidae</b> Leatherback Sea Turtles	174	<b>Typhlopidae</b> Blind Snakes	348
<b>Emydidae</b> New World Hardshelled Turtles	174	<b>Xenodermatidae</b> Strange-skinned Snakes	351
<b>Platysternidae</b> Asian Big-headed Turtles	174	<b>Xenopeltidae</b> Sunbeam Snakes	352
<b>Testudinidae</b> Tortoises	175	<b>Xenophidiidae</b> Spine-jawed Snakes	353
<b>Trionychidae</b> Softshell Turtles	176	<b>Glossary of Technical Terms</b>	<b>354</b>
<b>LIZARDS</b>	<b>178</b>	<b>Selected Bibliography</b>	<b>356</b>
<b>Agamidae</b> Agamid Lizards	178	<b>Internet Resources</b>	<b>367</b>
		<b>Index</b>	<b>369</b>

This work is dedicated to the memory of six early explorers and scholars of South-East Asian herpetology: Heinrich Boie (1794–1827), Heinrich Kuhl (1797–1821), Henri Mouhot (1826–1861), Malcolm Arthur Smith (1875–1958), William Theobald (1829–1908) and Frank Wall (1868–1950).

I owe a debt to my editor, Krystyna Mayer, for putting this project together, for her editorial acumen and patience.

I am deeply grateful to illustrators Robin Budden, Sandra Doyle, Rachel Ivanyi, Szabolcs Kokay, Jonathan Latimer, Denys Ovenden and Lyn Wells, whose artistic skills are evident from the finished product. Many of the illustrations were prepared from rather limited sources of information, such as text descriptions, photographs and museum specimens. Others in New Holland who helped the project take off include Ken Scriven, for his input and encouragement, James Parry, who originally conceived the project, and commissioning editor Simon Papps.

For information/images/translations/companion-ship during field trips, I am grateful to Kraig Adler, Natalia Ananjeva, Harry Andrews, E. Nicolas Arnold, Kurt Auffenberg, the late Walter Auffenberg, Mark Auliya, Christopher Austin, Raul Bain, David Barker, Aaron Bauer, David Bickford, Vladimir Bobrov, Wolfgang Böhme, Timothy Brophy, Rafe Brown, John Cadle, Ashok Captain, Chan Chew Lun, Lawan Chanhom, Joseph Charles, Michael Cota, Merrel Jack Cox, Jennifer Daltry, Ilya Darevsky, Patrick David, Stuart Davies, Geoff Davison, Maxmilian Dehling, Arvin C. Diesmos, Cheong-Hoong Diong, Julian Dring, David S. Edwards, Linda Ford, Jack Frazier, Uwe Fritz, Maren Gaulke, Genevieve Gee, Frank Glaw, David Gower, Ulmar Grafe, Allen Greer, Jesse Grismer, Lee Grismer, Wolfgang Grossmann, Andreas Gumprecht, Rainer Günther, Alexander Haas, Jacob Hallermann, Amir Hamidy, James Hanken, Harold Heatwole, Ronald Heyer, Tsutomu Hikida, Marinus Hoogmoed, Rick Hudson, Jaafar Ibrahim, Ivan Ineich, Robert Inger, Djoko Iskandar, John Iverson, Karen Jensen, Jiang Jian-Pe, Ulrich Joger, Vladimir Kharin, Arnold Kluge, André Koch, Gunther Köhler, Gerald Kuchling, Umi Laela, Maklarin Lakim, Edgar Lehr, Tzi-Ming Leong, Alan Leviton, Harvey Lillywhite, Lim Boo Liat, Kelvin Kok Peng Lim, Colin McCarthy, William McCord, Jimmy McGuire, Steven Mahony, Anita Malhotra, Edmond Malnate, Ulrich Manthey, Joseph Martinez, Masafumi

Matsui, the late Sherman Minton, Akira Mori, G. Mumpuni, John Murphy, Jonathan Murray, the late Jarujin Nabhitabhata, Ngo Van Tri, the late Wirot Nutphand, Peter Kee Lin Ng, Samhan bin Nyawa, Cord Offermann, Nikolai Orlov, Mark O'Shea, Hidetoshi Ota, Steve Platt, Peter Praschag, Peter C. H. Pritchard, Ding Qi Rao, Arne Rasmussen, Jens Rasmussen, Anders Rhodin, Herbert Rösler, José Rosado, Charles A. Ross, John Rudge, Klaus-Dieter Schulz, Saibal Sengupta, Rick Shine, Gerold Schipper, Irwan Sidik, the late Joseph Slowinski, Hobart Smith, Bryan Stuart, Robert Stuebing, Jeet Sukumaran, Tan Heok Hui, Tog Tan, Kumthorn Thirakhupt, Frank Tillack, Michihisa Toriba, Truong Nguyen, the late Garth Underwood, Jens Vindum, Peter Paul van Dijk, Johan van Rooijen, Miguel Vences, Gernot Vogel, Harold Voris, Van Wallach, David Warrell, Romulus Whitaker, Antony Whitten, Guin Wogan, Perry Wood, Wolfgang Wüster, Norsham Yaakob, Paul Yambun, Yuichirou Yasukawa, Darren J. Yeo, Yong Hoi Sen, Pui Min Yong, Timothy Youmans, Er-Mi Zhao, Zhou Ting, Thomas Ziegler, Nikolay Zinenko and George Zug.

I am grateful to Andrew Alek Tuen, Director, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, and my other colleagues at this institute. I am thankful to my wife, Genevieve V.A. Gee, for the unenviable chore of reading the proofs, as well as for looking after the household during the time spent writing and researching for this book. Finally, my thanks to my friend, Patrick David, Musée National d'Histoire Naturelle, Paris, for his comments on the manuscript before its final journey to the press.

#### Abbreviations and Conventions

**ASEAN** Association of South East Asian Nations

**asl** above sea level

**ca** circa

**IUCN** International Union for Conservation of Nature and Natural Resources

**nr** near

**SCL** straight carapace length (of turtles)

**SVL** snout-vent length (of most lizards)

**TL** total length (of snakes and anguillid lizards)

This book provides a convenient means for both non-specialists and professional herpetologists working in the field to identify all valid species of reptile currently known in South-East Asia. In this work, South-East Asia refers to all political entities on the Asian mainland east of India and south of China, and bordered by the Sahul Plate to the south (see page 13 for further details).

Given the intense sampling now taking place in many countries in the region, and from habitats that were until recently inaccessible, new species discoveries, as well as rediscoveries of species hitherto known only from textual descriptions, are now routine. New methods for differentiating cryptic species, especially molecular techniques, have also added significantly to the arsenal for species prospectors. A work of this nature is thus likely to become rapidly outdated, and one hopes it can be revised at periodic intervals, incorporating all new information that becomes available.

Not all species covered here can be reliably recognized in the field: for a number of groups, particularly within the squamates (lizards and snakes), reliable identification can be carried out only after careful scale counts, in addition to examination of dental and hemipeneal structures, which is challenging to all except those with access to a microscope or at least a good hand lens.

#### DEFINING REPTILES

Unlike mammals and birds, which are natural units (or share a common ancestry), reptiles are not easy to define. Contemporary classifications based on both bones and molecular data show that modern birds are 'nested' well inside the group. Exclusion of these feathered cousins therefore renders 'reptiles' incomplete. Reptiles belong to a natural group called 'amniotes', which is characterized by the production of water-tight eggs that are relatively better buffered from the external environment than the eggs of other vertebrates, such as fish and frogs. Amniotes comprise most of the land vertebrates, including mammals, birds, turtles, the tuatara, lizards, snakes and crocodiles. Within this group, with a membership of 20,000 species, are the classes Synapsida, which includes mammals, and Sauropsida, which embraces all other groups (including reptiles and birds). In the latter group, the turtles have been argued to be either the sister group to the clade Sauria, or a sister group to the superorder Lepidosauria. Recent molecular evidence also shows a close relationship between birds and crocodilians. Adding extinct amniotes contributes further complexity to these relationships.

'Reptiles' as defined in this work follows Gauthier et al. (1988) in including 'the most recent common ancestor of extant turtles and saurians, and all of its descendants plus, following conventional usage in the herpetological literature, crocodilians'.

#### MORPHOLOGICAL SPECIALIZATIONS

While the monophyly (descent from a common ancestor) of the group, as traditionally defined, is itself in question, the use of the word 'reptiles' in this work refers to crocodiles, turtles, snakes and lizards, which do share a number of morphological features. These include: a. a tabular (bone on the posterolateral corner of the skull table) that is small when present; b. a suborbital foramen (hole under the eyeball); c. a supraoccipital anterior crista (prominent ridge above the orbit) and d. a narrow supraoccipital plate (median bone at the back of the skull, which borders the foramen magnum).

#### CROCODILES

Crocodiles (order Crocodylia) and their relatives today comprise just three living families with about two-dozen species, although a rich assemblage existed in former times. They are some of the largest of living reptiles. They have an enlarged head with powerful jaws equipped with numerous conical and pointed teeth; a broad and posteriorly flattened skull; external ear openings; shortened forelimbs and a long to extremely long elongated snout. A 'third eyelid', the nictitating membrane, covers the eyes while they are underwater. Other external characteristics shared by crocodiles and their close kin, alligators, include rather tough scaled skin, webbed feet and a laterally compressed, muscular tail bearing distinct ridges, the last two features being associated with a life in water and swimming.

Internal characteristics shared by the group include a skull with temporal fenestrae (bilaterally symmetrical holes in the temporal bones); well-developed neural spines (spinous processes of the vertebral column); a well-developed secondary palate and a four-chambered heart.

#### TURTLES AND TORTOISES

The order Chelonii (Chelonia or Testudines of some authors) includes turtles, tortoises and terrapins, which are arguably the most easily recognizable group within the reptiles. They are characterized by external features such as a lack of teeth (in all living species), and most famously by a shell located above (the carapace) and underneath (the plastron) the body. The carapace and plastron are associated with protection of the head, limbs, tail and internal organs, and derive from the fusion of the vertebral column with the ribs, sternum, and pectoral and pelvic girdles. Significantly, the girdles are located inside the ribs. A majority of turtles have added another element to this nearly impregnable fortress – a layer of keratinized scutes or scales, further reinforcing the shell.

Only a few families of living turtles have done away with scutes altogether, and have a bony shell enveloped by leathery skin. Shell scutes of juvenile Leatherback Turtles (*Dermochelys coriacea*) are lost

## IDENTIFICATION OF REPTILES

In many South-East Asian reptiles, body size, shape, form, colour and patterning are diagnostic. In

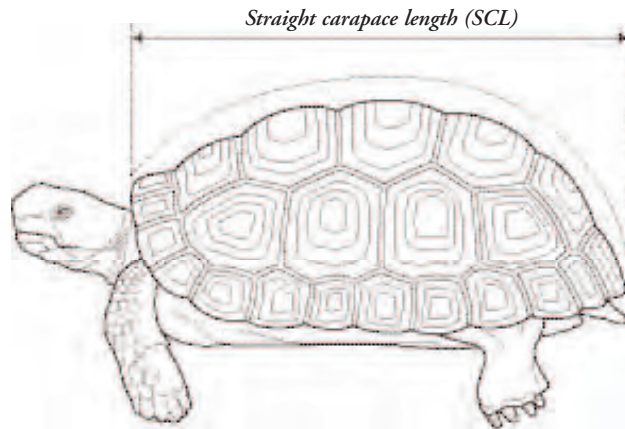
lizards and snakes, scale patterns and counts on the head and body are often key to identification.

### MEASUREMENTS OF SIZE

#### Turtles, Terrapins and Tortoises

There are several ways of assessing the size of turtles, terrapins and tortoises. The size of the species in this

book is reported as the measurement along the midline of the straight length of the carapace (SCL).



#### Lizards

For all lizards apart from glass snakes, size is determined by measuring the body length from snout to vent (SVL), rather than the total length. Many

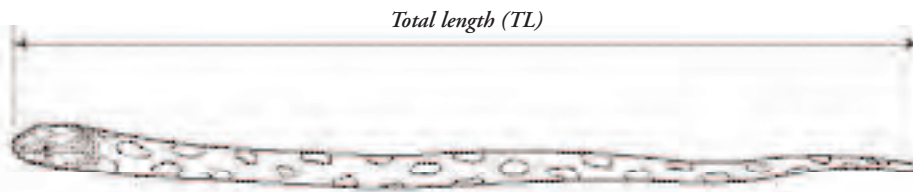
lizards may lose and regenerate their tail, so knowledge of their total length is of little advantage for identification purposes.



#### Snakes and Glass Snakes

In this book, the size of snakes and glass snakes (a group of mostly limbless lizards) is reported as

total length (TL), measured from the tip of the snout to the tip of the tail.

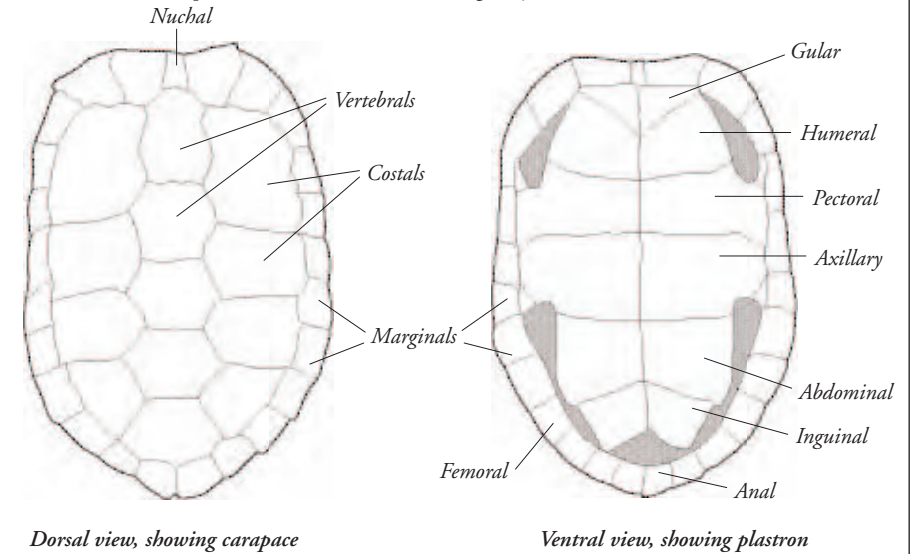


## MORPHOLOGICAL TRAITS AND SCALE TYPES

#### Turtles, Terrapins and Tortoises

The scales (or scutes) on the hard, bony upper shell (carapace) and lower shell (plastron) of hardshelled

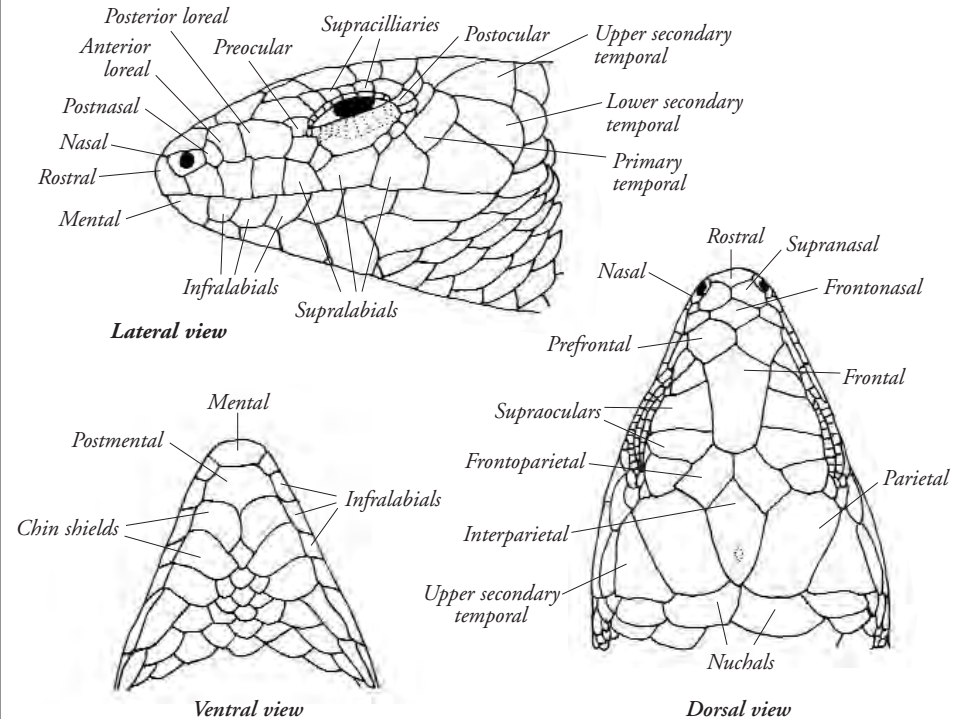
tortoises and turtles are arranged in a specific manner and greatly facilitate identification.



#### Head Scales of Lizards

Scale position and size are useful pointers in the identification of lizards (and snakes, see page 10).

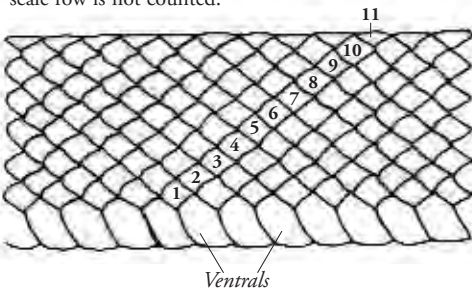
The positions and names of the scales are more or less typical in most squamates.





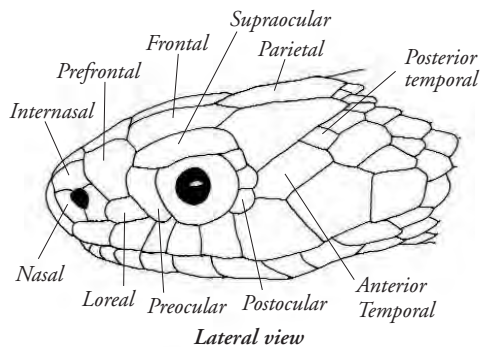
### Body Scale Counts of Snakes

Counts of the number of scale rows on a snake's body are useful for identifying species. A body scale count is made midway between the head and the cloaca, where the number of rows is the highest. The ventral scale row is not counted.



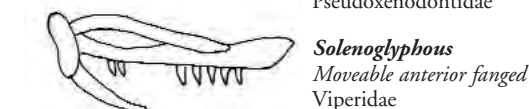
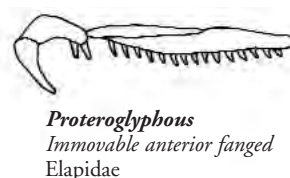
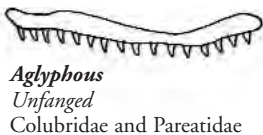
### Head Scales of Snakes

The scales on the heads of lizards can be identified by their shape and relative position.



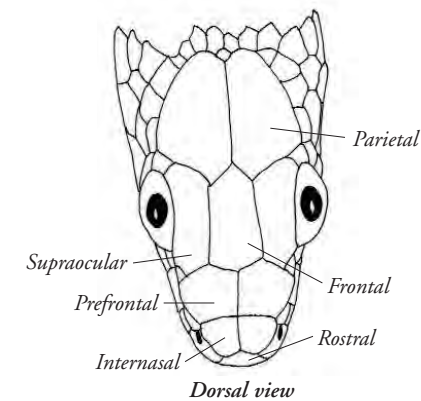
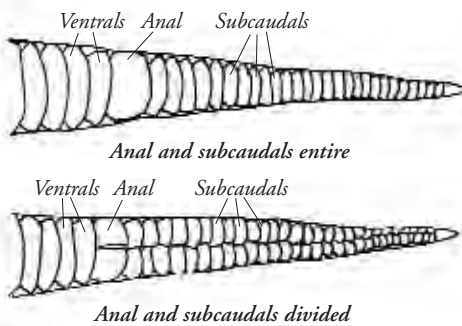
### Dentitional Types in Snakes

Snakes can be placed in one of four groups, according to the form of teeth they have, which is associated with the method used to capture and kill prey. Snake teeth can grow back when lost, and snakes may have several sets of teeth throughout their life – this is necessary because their teeth are often lost during feeding. In **aglyphous snakes**, which are not venomous, each tooth is more or less the same shape and size. **Opisthoglyphous snakes** are similar to aglyphous snakes, but possess weak venom, which is injected by a pair of backwards pointing, enlarged teeth at the back of the maxillae (outer front upper



### Tail Scale Counts of Snakes

The 'subcaudal scale count' is the number of scales, or pairs of scales (depending on the species) under the tail. The count is made from the first scale or pair of scales below the anal, to the scale just in front of the terminal scale at the tail-tip.



jawbones). The snake must bite the prey, move it to the back of its mouth in order to penetrate it and allow the venom to seep into it along grooves in the fangs. In **proteroglyphous snakes** a substantially enlarged 'fang' in front of the oral cavity points downwards and folds around a venom channel, forming a hollow needle that is injected into prey. **Solenoglyphous snakes** have the most sophisticated venom delivery method, unique to the vipers. The fangs are long and typically folded back. Vipers can open their mouths to almost 180 degrees, and the fangs swing into position to allow them to penetrate deep into prey.

with growth, being replaced by smooth skin in adults. Aquatic turtles tend to have webbed feet and streamlined shells, while tortoises predictably possess fingers and toes free of a web, and more rounded or elevated shells. In several highly aquatic freshwater turtles, such as the river terrapins *Batagur affinis* and *B. baska*, the snout is upturned and the nostrils are placed relatively high, permitting respiration with the rest of the body submerged.

Internal characteristics associated with the group include an akinetic (with non-moving components) skull; a complete or emarginated temporal region, lacking temporal fenestrae; reduced dermal roof elements; no parietal foramen (opening in the midline of the skull roof containing a sensory organ) and a shoulder girdle that is internal to the ribs and shell.

### LIZARDS AND SNAKES

The order Squamata comprises the final grouping within the reptiles, and contains two groups – the lizards and snakes. Although these groups are externally easy to tell apart (except for the several unrelated groups of limbless lizards, and snakes with vestiges of hind limbs, mentioned below), they are united in possessing the following external characteristics: a relatively slender body covered with scales; frequently, a parietal foramen (a light-sensitive organ); paired hemipenes and numerous sharp teeth. Increased capacity of movement by their skulls and mandibles (compared to that of turtles and crocodiles) permits members of the Squamata to ingest relatively large prey.

Internal characteristics uniting members of the group include a single temporal arch (which has been lost in the gekkotans and snakes); a moveable quadrate; a single temporal fenestra and median cranial elements, including premaxillae, frontals and parietals, which are frequently fused, and show the loss of the temporal arch (the bridge-like extension of the jugal and squamosal bones).

The fundamental differences between the two groups are ecological rather than morphological – lizards are primarily predators of invertebrates, while snakes tend to consume vertebrates. Nonetheless, the numerous exceptions to the rule tend to complicate matters, and several large-growing lizards are also known to consume snakes (in addition to other, sometimes large vertebrates).

A number of lizard families have secondarily lost their limbs (or have degenerated hind limbs), most famously within the Anguidae, Dibamidae and Scincidae families. Meanwhile in members of the Pythonidae and Boidae snake families, vestiges of hind limbs exist in the form of cloacal spurs.

Snakes have a spectacle or brille covering their eyelids, giving them the characteristic 'unblinking' stare, while lizards tend to have moveable eyelids (exceptions being members of the Gekkonidae family). Snakes also lack palpebrals (enlarged scales forming the upper eyelid), a parietal eye and foramen (the 'eye' being a sensory structure opening through the top of the skull), a tympanum, a pectoral girdle

and forelimbs. A number of characteristics in snakes, such as a long, thin forked tongue, recurved teeth and male combat, are shared with one group of lizards – the monitors – suggesting a close relationship.

### REPTILE ECOLOGY

#### USE OF HABITAT

The greatest species richness of reptiles occurs in tropical rather than temperate regions of the world, due in part to the complexity of available habitats and microhabitats, greater diversity of prey types, and prevailing climatic conditions (including aseasonality, permitting year-round activity), in addition to other factors (such as geological history).

Reptiles inhabit a broad range of habitats in South-East Asia, including grasslands, freshwaters and peat swamps, dry deciduous forests, lowland dipterocarp forests, karst-dominated forests, montane forests, sea coasts and coral reefs. Within a region, more species and larger communities of reptiles are encountered in lowland forests than in the highlands or in other habitats. In moist deciduous forest settings, for instance, species space themselves out, presumably to reduce competition. Within such communities there may be terrestrial and fossorial forms, in addition to arboreal and aquatic ones.

In many natural reptile communities, habitat specialization is evident. Thus, rock-dwelling geckos equipped with specialized scansors-scales on their fingers and toes may scuttle over karst limestone regions, while arboreal snakes ascend apparently effortlessly to the forest canopy, aided by keeled ventral scales and binocular vision. In a similar setting, fossorial species may seem to effortlessly disappear into loose soil, into which they dig with their sharp snouts, resistance to their passage being reduced through the development of highly polished scales that make them appear iridescent. Adaptations in aquatic snakes include the dorsal (as opposed to lateral) placement of the nostrils and eyes, a streamlined body and, in the case of sea snakes, the flattening of the tail-tip, enabling it to function somewhat like a paddle.

#### TIME OF ACTIVITY

Time of activity is another dimension ecologically separating species, and two obvious categories here are diurnal (day-active) species, which have rounded pupils, and nocturnal (night-active) species, with elliptical pupils. Breaking down this division somewhat are species that are crepuscular, active during the low light associated with dawn or dusk, these tending to possess elliptical pupils.

Timing of activity may remain unchanged throughout the year in some species, or fluctuate seasonally. Certain species may display a bimodal activity pattern, depending on ambient temperature regimes or the activity of specific prey species. Other species, such as those that inhabit the tropical rainforest floor, are most active under conditions of reduced light by day.

## THE SENSES

For such a diverse group of organisms, generalizations on sensory biology tend to be difficult. Within the groups, sight ranges from good in the case of the binocular vision of certain tree snakes (genus *Ahaetulla* and others), critical for judging distances, to non-existent, as in several species of burrowing blind snake (genus *Typhlops*) that lack externally visible eyes.

Hearing is similarly reduced in the reptiles, and snakes have been widely considered 'deaf', although recent experimental data shows that the relatively vocal King Cobra (*Ophiophagus hannah*) may well be capable of perceiving some sound in the form of air-borne vibrations.

Olfactory senses are better developed throughout the group, and may be critical for finding food and detecting the odour of conspecifics, particularly during the breeding season. Pit vipers also possess enlarged pits, located between the nostrils and eyes, and pythons labial pits, whose function is to detect the warmth of endothermic prey in darkness.

Finally, mention needs to be made of the Jacobson's organ, situated on the palate of snakes and some lizards, where the two-tined tongue is applied after sampling the external environment to sense its chemical nature, including the possible presence of prey and predatory species.

## SOCIAL RELATIONSHIPS

Reptiles tend to be solitary. Social behaviour is the exception rather than the norm, and reptiles aggregate only seasonally, for reproduction – for example during the 'arribadas' or mass-nesting of the Olive Ridley Sea Turtle (*Lepidochelys olivacea*) – or for hibernation in communal sites (as in snakes in temperate regions). Lack of appropriate exposed sites may also force turtles to bask in large numbers on banks and on logs. Parental care is relatively rare within reptiles, and the most famous examples occur among the crocodilian species, which remain near nests and with their emergent young for a few days, much like the birds to which they are distantly related.

## ANTI-PREDATOR RESPONSES

Defensive behaviour enhances survival among living organisms, and a variety of strategies is employed by reptiles. In order to stay out of sight of their enemies, a majority of reptiles have colours and patterns that can be described as 'surface mimicry' or crypsis, being hardly discernable from their surroundings. Others display warning coloration to advertise their bite (such as the venomous *Calliophis* or coral snakes). Many use flight as an effective way of rapidly escaping from a threatening situation. Still others feign death, becoming immobile to the touch or manipulation by a potential predator, turning into a ball of coils or expanding parts of their body, all with the intention of confusing the would-be predator.

Venomous snakes, especially vipers and cobras, may hiss, expelling inhaled air in an act of displeasure, while warning of a lethal bite. Cobras may additionally raise their head and spread a hood, a

behaviour mimicked by a few groups of unrelated and non-venomous snakes. Some species, while non-venomous, adopt colours of unrelated venomous species, thereby gaining the advantage of protection in being mistaken for a dangerous snake.

A few groups of lizards, most famously the geckos and skinks, can readily detach their tail (caudal autotomy) at signs of danger, at a predetermined fracture plane within the caudal vertebrae. The lost tail is gradually replaced, but may differ in shape and size, and the bone is replaced by a cartilaginous rod. Caudal autotomy (but apparently without regrowth) is also known in snakes of the families Natricidae (genus *Amphiesma*) and Colubridae (genus *Sibynophis*), and occurs between the caudal vertebrae.

## HEAT CONTROL IN THE BODY

A majority of the world's living reptiles display ectothermy, whereby the body temperature depends primarily on the absorption of heat energy from the environment. This is fundamentally different from the condition in birds and mammals, which employ endothermy, where the body temperature is dependent primarily on heat produced via the metabolism, and the dissipation of heat to the environment. However, the body temperature of reptiles is not controlled by a single environmental temperature, and individual reptiles are capable of actively regulating their body temperature through the selection of substrates or microhabitats that show a range of temperatures. Typically, an increase in body temperature is achieved by basking, through obtaining heat from the sun. Other ways to gain or lose heat include absorbing heat from the substratum, panting or shunting heat away from extremities exposed to the cold. Ectotherms thus need to allocate a lower proportion of the energy derived from food to maintaining an optimal body temperature, relative to endotherms.

## DIETS AND FORAGING

Few reptiles are herbivores, and those that are tend to be large in body size compared to their carnivorous relatives. One explanation for this is that, being large, reptiles cannot harvest enough animal prey food, and are thus facultatively herbivorous. The juvenile stages of these species (including iguanians, sea turtles and freshwater turtles) display carnivorous habits.

Carnivorous reptiles hunt in two distinct ways. Sit-and-wait species wait in ambush for their prey, detecting it visually. They employ relatively low levels of activity and appear to have poorly developed chemosensory systems. Examples of these species include agamid lizards and geckos. On the other hand, widely foraging species such as monitor lizards actively hunt for prey, using more developed chemosensory systems. These species show high activity levels and appear to harvest more prey calories per unit time.

Dietary specializations are relatively rare in reptiles compared to other vertebrate groups. The most widespread example is a diet of ants in flying lizards (agamid lizards of the genus *Draco*). Other specialized

diet types include earthworms (colubrid snakes of the genera *Blythia*, *Calamaria* and *Plagiopholis*), freshwater and land snails (geoemydid turtles of the genus *Malayemys* and members of the snake family Pareatidae), softshelled crabs (homalopsid snakes of the genus *Fordonia*) and fish (crocodilians of the Gavialidae family and the Hydrophiidae sea snakes). Some snakes have further specialization: those of the genus *Psemmodynastes* consume heavily scaled vertebrates (including fish, skinks and other snakes), and one sea snake, the Beaded Sea Snake (*Aipysurus eydouxii*), eats only fish eggs.

## REPRODUCTIVE DIVERSITY

A majority of reptiles reproduce sexually and produce eggs that hatch outside the mother's body. Notable exceptions include the presence of a single sex in some species, represented in the region by several geckos and the ubiquitous Brahminy Blind Snake (*Ramphotyphlops braminus*), which are all-female species. Within reptiles that produce eggs (oviparous), clutch size and offspring size are typically related to other aspects of the ecology of the species. While larger females can produce larger eggs and/or larger clutches, other considerations may be important. These include the number of times a female can breed in a season, and whether additional parental investments, such as care of the eggs and/or neonates, are required. A few species employ ovoviviparity or egg-retention within the body of the female – a form of parental care. All species of crocodilians, turtles, terrapins and tortoises are oviparous.

Foraging strategies, described earlier, are known to influence reproduction. For instance, the clutch size of widely foraging species tends to be smaller than that of sit-and-wait ones, as members of the former group cannot weigh themselves down while pursuing prey. Clutch size itself is subject to considerable variation, even within orders. Within turtles, it may range from a single, relatively large egg, as in the Spiny Hill Turtle (*Heosemys spinosa*), to more than 150 eggs in the marine turtles. Among squamates, clutch size may range from a single egg in Sauter's Keelback (*Amphiesma sauteri*), to 124 eggs in the Reticulated Python (*Broghammerus reticulatus*).

## REGION COVERED

The region currently referred to as South-East Asia was variously referred to as 'Indes Orientalis' or 'Eastern India' in medieval Europe, and in even earlier times as 'Land below the Wind and Golden Khersonese' (literally, 'land of gold') by Arab and Indian seafarers. Interest in the region grew from the 1500s, fuelled primarily by the desire for spices and timber. Centralized societies existed here well before this time in north-eastern Thailand (between 1400 and 1000 BC), and these had extensive trading connections with societies in China and India. Subsequently, other important political centres developed, including Co Loa in Vietnam and Fu-Nan in Cambodia. Following the retreat of the European

colonial powers around the middle of the 1900s, several nation states emerged, which formed the Association of Southeast Asian Nations (ASEAN). The members of this primarily economic block comprise Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Singapore, Indonesia, Brunei Darussalam, the Philippines and Timor Lesté.

In this work, South-East Asia refers to all political entities on the Asian mainland east of India and south of China, and bordered by the Sahul Plate to the south. (See also map on front endpapers, and map on back endpapers for topography.) Thus, the eastern islands of Indonesia, including New Guinea, have been omitted, as have the archipelagic nations of Timor Lesté and the Philippines. Brief introductions to the countries whose reptile fauna is dealt with in this work are given below.

### Brunei

Negara Brunei Darussalam, total land area 5,270sq km, is located on the north-western coast of Borneo, and is divided into two parts, both wedged into the Malaysian State of Sarawak. To its north is the South China Sea, and it has a coastline of 161km. The capital is Bandar Seri Begawan. The climate is aseasonal, tropical. The coastal plains on the eastern sector rise to mountains further south; on the western sector beyond the coastal plains lie extensive lowland and hill dipterocarp forests. The highest mountain is Bukit Pagon (1,850m asl). The human population in 2008 was 381,371. Environmental problems relevant to biodiversity include logging on Brunei's borders and smoke from forest fires, resulting in haze. Important centres for protection of biological diversity include the Temburong National Park and the Pulau Selurong Nature Reserve.

### Cambodia

The Kingdom of Cambodia, total land area 176,520sq km, is part of the region popularly referred to as 'Indo-China', and borders the Gulf of Thailand in the south. Its political boundaries include Thailand to the west and north-west, Vietnam in the east and Laos to the north-east. The coastline is 443km in length. The capital is Phnom Penh. Subtropical monsoon forests characterize Cambodia, and there is a distinct dry season. The topography is essentially low and flat, with mountains in the northern and south-western parts of the country. Major wetlands include the Mekong River and the great lake of Tonle Sap. The highest mountain is Phnom Aural (1,810m asl). The human population in 2008 was 14,241,640. Issues relevant to the protection of biological diversity include loss of forest cover as a result of the removal of timber, and mining for gems. Important areas for biological diversity conservation include the Kirirom National Park, Phnom Bokor National Park and Botum-Sakor National Park.

### Indonesia

The Republic of Indonesia, total land area 1,826,440sq km, straddles the archipelagos between



the Indian Ocean and the Pacific Ocean. Indonesia shares just three of the 17,508 islands with other political entities – Borneo with Malaysia and Brunei, Timor with Timor Leste, and New Guinea with Papua New Guinea. It has a coastline of 54,716km. The capital is Jakarta. The climate of the islands of Indonesia is mostly aseasonal and tropical, with the highlands experiencing a cooler climate. The coastal plains give rise to tall mountains, chiefly on the larger islands. The highest mountain is Puncak Jaya (5,030m asl) on New Guinea. The human population in 2008 was 237,512,352. Major environmental problems include logging for timber, the clearing of land for shifting cultivation and industrial pollution. Areas gazetted for protection of biological diversity within the Greater Sundas include Meru Betiri National Park, Kerinci Seblat National Park and Bentuang Karimun National Park.

#### **Laos**

The Lao People's Democratic Republic, total land area 230,800sq km, is another country of Indo-China, bordering Vietnam on the west, and is north-east of Thailand and north of Cambodia. It has a short border with China in the north, and is landlocked. The capital is Vientiane. The climate is subtropical with distinct dry and wet seasons in the north, more tropical in the south. Laos has large tracts of primary forests, and the land itself is mostly rugged with some plains. The Mekong River forms part of the western boundary, and the highest peak is Phou Bia (2,817m asl). The human population in 2008 was 6,677,534. Important issues in biodiversity conservation include deforestation and the presence of unexploded ordnance. Protected areas include the Nam Et and Phou Loei National Biodiversity Conservation Area, Phu Luang National Biodiversity Conservation Area and Khammouane Limestone National Biodiversity Conservation Area.

#### **Malaysia**

Malaysia, total land area 328,550sq km, is bisected into two parts: on the South-East Asian mainland it forms the long peninsula jutting into the South China Sea, and on the island of Borneo it occupies the twin states of Sarawak and Sabah. On the mainland it is bounded by Thailand to its north; on Borneo it is bounded by Kalimantan (Indonesia); the independent Sultanate of Brunei is wedged within the state of Sarawak. Malaysia has a coastline of 4,675km. The capital is Kuala Lumpur. The climate is primarily aseasonal, tropical, the northern states of Peninsular Malaysia showing a hint of the dry season. The land itself includes coastal plains, rising to mountains in the interior. The highest mountain is Gunung Kinabalu on Borneo (4,100m asl). The human population in 2008 was 25,274,132. Factors that threaten biodiversity include loss of forest cover as a result of commercial logging, clearance of land for shifting cultivation and perhaps also hunting. Important areas for biodiversity include Taman Negara, Bako National Park, Lambir Hills National Park and Gunung Kinabalu Park.

#### **Myanmar**

The Union of Myanmar ('Burma' up to 1989), total land area 657,740sq km, is the most north-western country in South-East Asia. It borders the Andaman Sea and Bay of Bengal to the east, sharing borders on the north and north-east with Bangladesh, India and China. To its west is a narrow contact with Laos, and in the south-east it contacts western Thailand. Its coastline is 1,930km in length. The capital is Yangon. The climate can be described as tropical monsoon, the lowlands of central Myanmar being ringed on all sides by gentle to steep mountains, including the highest mountain in South-East Asia (Hkakabo Razi, 5,881m asl). The human population in 2008 was 47,758,180. The key environmental problem related to biological diversity is loss of forest cover as a result of timber harvesting. Important protected areas include Kathapa National Park, Popa Mountain Park and Chhatin Wildlife Sanctuary.

#### **Singapore**

The Republic of Singapore, total land area 682.7sq km, is an island state located at the southern tip of Peninsular Malaysia. It has a coastline of 193km. The local climate of this city-state is aseasonal, tropical. While most of the island comprises relatively flat areas, the central plateau is gently undulating. The highest point is Bukit Timah (166m asl). The human population in 2008 was 4,608,167. Threats to local biodiversity include fragmentation and industrial pollution. Important protected areas include Bukit Timah Nature Reserve, Pasir Ris Park and Sungei Buloh Wetland Reserve.

#### **Thailand**

The Kingdom of Thailand (formerly Siam), total land area 511,770sq km, borders the Andaman Sea and Gulf of Thailand in the west and south, Myanmar to the north-east and east, northern Peninsular Malaysia in the deep south, and the Indo-Chinese countries of Laos and Cambodia on the north-east, east and south-east. The coastline is 3,219km in length. The capital is Bangkok. The climate is subtropical with a distinct dry season in the north, more aseasonal in the southern peninsula. Apart from the dry central plain and low-lying areas of the south, much of the country is mountainous, especially along the borders. The highest mountain is Doi Inthanon (2,576m asl). The human population in 2008 was 65,493,296. Factors that threaten local biodiversity include deforestation, and hunting and gathering of wildlife. Important areas for biological diversity include Khao Yai National Park, Doi Inthanon National Park and Phu Kao-Phu Phan Kam National Park.

#### **Vietnam**

The Socialist Republic of Vietnam is the largest country in Indo-China, with a total land area of 325,360sq km, and borders the Gulf of Thailand, the Gulf of Tonkin and the South China Sea. To the north it is bounded by China, in the east by Laos, and west of southern Vietnam is Cambodia. The coastline is

3,444km in length. The capital is Hanoi. The climate ranges from subtropical monsoon in the north, with distinct dry and wet seasons, to aseasonal tropical in the south. The landscape consists of extensive low-lying areas, including deltas, as well as mountains in the northern, north-western and central regions. The highest mountain is Fan Si Pan, currently known as Phang Si Pang (3,144m asl). The human population in 2008 was 86,116,560. Major factors that threaten biological diversity include agricultural practices such as slash-and-burn agriculture, and also logging. Important areas for biodiversity include Phong Nha-Ke Bang National Park, Vu Quang National Park and Cat Ba Island National Park.

### **THE ENVIRONMENT**

The richness of plant and animal life in the region referred to as South-East Asia is attributed to two factors – geological history and present-day climate – and a number of reptile lineages are found nowhere else in the world. Several groups, especially geckos and skinks, reach their greatest diversification in the region, having terrestrial, arboreal, fossorial and even aquatic forms.

Historically, nearly all of South-East Asia was covered with humid tropical forests, although some regions, including parts of central Myanmar and Sumatra, were naturally dry and supported savannah-type vegetation. Others, such as the Annamite (Truong Son) Mountains and north-western Borneo, remained unaffected by the glacials, and thus harbour ancient lineages of animals and plants.

Starting in the 19th century, the logger and his chain-saw has been the most destructive of all to arrive in the region. Vast swathes of once-forested land have been cleared from South-East Asia, and the pace of forest-clearing stops locally only when all of the commercially valuable trees have been removed. The effects of this practice on the land's biodiversity, not to mention the soil, water and human well-being, have been nothing short of catastrophic.

### **REPTILE CONSERVATION**

Reptile exploitation in South-East Asia ranges from the occasional capture of a gigantic python or sea turtle by indigenous groups for subsistence, to large-scale removal of turtles, lizards and snakes for the food and traditional medicine trade. Hunting pressure can be intense, and is matched only by the acceleration of habitat loss, particularly in the last 30 years. Several local species of turtle and at least two crocodilians are now seriously threatened, and the status of many more species is unclear due to lack of scientific data on identities, populations and distribution.

Few reptile species are deemed charismatic by the general public, and few are scientifically managed. Indeed, conservation and management priorities are generally set by non-biological criteria such as economic value and appeal. Nonetheless, a number of species are known to be of importance to ecosystems

and local food webs, and have been identified as key to helping maintain such functions. Additionally, reptiles can aid the dispersal of plants, function as beneficial scavengers, facilitating the release of nutrients locked up in dead tissue, and help to control agricultural pests including rats and mice, and locusts and other insect pests. Unfortunately, reptiles are on the menu of other predatory vertebrates and invertebrates, including humans, several life-saving drugs are derived from snake venoms, and innumerable folk remedies and indigenous systems of medicine are based on various reptile body parts.

A number of actions can be recommended to augment the conservation of reptiles regionally. Identification of species in need of protection is an obvious first step. While progress has been substantial for turtles and crocodiles, the conservation status of most lizard and snake species remains unknown. Efforts need to be made to produce inventories of areas with intact forest cover, especially global and regional hotspots, in order to understand species' distribution and habitat association. Also needed are life-history studies on local reptile assemblages that will provide scientific information on aspects of their ecology and behaviour, which is essential for their conservation and management.

Habitat protection, especially the conservation of lowland rainforests (a majority of local reptiles are restricted to these forests), is fundamental in the conservation of reptile biodiversity. Also in need of protection are specialized forest types such as mangrove and peat swamps, montane forests and limestone karst areas, each of which harbours unique assemblages of reptile species. Efforts also must be made to connect existing protected areas in order to create potentially larger areas under natural forest cover, thus increasing the viability of populations within them.

Trade in wildlife is the earliest occupation of humans, and while a small degree of sustainable use (in non-consumptive forms, such as ecotourism) can sometimes be encouraged, large-scale organized trade, targeting selected species for overseas markets, should be strictly monitored, controlled and – in the vast majority of cases – stopped altogether.

Finally, the socio-cultural value of reptiles across the many cultures of South-East Asia is a much-neglected area of study. Important insights can be gained from such studies that can add to our knowledge of reptile biology, while at the same time enhancing conservation practice.


### **BOOK ORGANIZATION**


This work covers all currently valid species known from the region. The cut-off date for inclusion was 31 December 2008. A majority of the species are illustrated. For each species, the following are supplied:

1. **Common English name** (coining a new name in a few cases where no common name existed).

## 2. Current scientific name.

3. **Symbols** where relevant next to the common name. These denote a species that may pose a danger to humans. The symbols are as follows:

 **MILDLY VENOMOUS SNAKE** Bites from small snakes may cause slight envenomation in humans, while bites from adults of some snake species can cause mortality in humans.

 **DEADLY VENOMOUS SNAKE** Bites from these snakes may cause mortality in humans.

 **LARGE-GROWING REPTILE** Adults of these species may be dangerous to humans.

4. **Maximum length attained** Straight carapace length (SCL) in turtles, terrapins and tortoises; total length (TL) in crocodilians, snakes and anguid lizards; and snout-vent length (SVL) in all other lizards. See also diagrams on page 8. Size measurements of more than 200 millimetres are provided in metres; measurements below 200 millimetres are given in millimetres.

## MANAGEMENT OF SNAKEBITE

Snakes are most likely to bite humans when they have been startled, provoked and/or cornered. Make sure you familiarize yourself with the basic procedure for snakebite treatment before travelling to areas with venomous snakes.

Several well-known dangerously venomous snakes occur in South-East Asia. Among them are members of two families – the Elapidae (comprising cobras, kraits, coral snakes and sea snakes) and the Viperidae (consisting of the vipers, including pit vipers).

Venom from the Elapidae affects the nerves, hence 'neurotoxic' venom. It blocks the conduction of nerve impulses to muscles. Symptoms of venomous snakebite include loss of muscle control, which is manifested by drooping eyelids, a loss of muscle tone in the facial features and paralysis of the diaphragm, resulting in an inability to breathe.

Venom from the Viperidae affects the circulatory system and is called 'haematotoxic' venom. It damages the walls of the blood vessels. Symptoms of snakebite in this case include severe local pain and swelling, non-clotting of the blood and kidney failure.

Bites from some of the larger keelback snakes (including members of the genera *Rhabdophis* and *Macropisthodon*) may also be serious enough to warrant medical treatment for envenomation.

Antivenom should be administered only by qualified physicians, when signs of local or systemic envenomation are evident. Ideally, the antivenom used should be from the same species and from the same geographical area. A hospital in the tropics should have staff knowledgeable about local snakes of medicinal importance, and the possible symptoms of their bites. They should also have access to appropriate antivenom, and epinephrine to treat anaphylaxis. Other basic facilities for treatment of venomous snakebite include a system for assisted breathing (especially for serious cases of neurotoxic envenomation) and treatment for acute renal failure (for bites from vipers, especially *Daboia russelii*).

If someone you know suffers a snakebite, bear in mind the following:

- For bites from species belonging to the families Elapidae and Viperidae, arrange to transport the person to a hospital immediately.

- A person bitten by a snake needs to be calmed and reassured, and kept immobile as much as possible, as movement can increase the systemic absorption of venom.

- In the case of a bite by an elapid species, apply a pressure bandage (as firm as you would apply to a sprained ankle) to contain the venom and prevent it from spreading. Bandage as much of the limb as possible. Apply a splint to keep the limb immobile. Do not remove the bandage before professional help is available.

- An accurate description of the snake responsible for the bite greatly aids treatment. However, do not endanger yourself or others by trying to capture the snake for identification purposes.

- Elevate the bite site. This results in reduced blood flow to and from the bite site, slowing the spread of the venom.

- Do not apply a tourniquet unless you are a doctor. Oxygen starvation of a limb can cause more damage than the envenomation, and the procedure is rarely lifesaving.

- Do not allow the patient to consume alcohol, which elevates metabolism and promotes vasodilatation (widens the blood vessels), causing a more rapid onset of symptoms. Also do not administer stimulants or pain medication.

- Do not cut open the bite site, or try to suck out the venom.

Apart from the dangers posed by venomous snakes, large-growing members of several families (especially pythons) can give a painful, crushing bite, causing severe lacerations that require stitches.

5. **Morphological characters used in identification** (see also diagrams, pages 9–10).

6. **An account of coloration in life.**

7. **Description of diagnostic characteristics of sub-species** that occur in the region, where applicable.

8. **Notes on habits and behaviour**, including habitat associations, elevational range, unique habits, diet and reproduction, where known. Elevational range is given in metres above sea level (m asl). In lizard and snake families that are known to contain both oviparous and oviparous species, this information is given within the species accounts (where known). Where all species within a family are either oviparous or oviparous, this is stated in the introduction to the family only.

9. **Distributional range** within South-East Asia (country-wise) and notes on occurrence in extralimital areas. Localities are arranged in geographical order, starting from Myanmar in the north, to the islands of Indonesia in the south. For each country, if the taxon is widespread, no specific localities are provided. If it is represented by a few sites (typically less than five) locally, they are listed.

10. **Conservation status**, according to the 2008 IUCN Red List of Threatened Species, Red List Categories, Version 3.1 (2001) (<http://www.iucnredlist.org/>). The IUCN threat categories are as follows:

### EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

### EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

### CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

### ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

### VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

### NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable category now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

### LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

### DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its range and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or range are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more data is required and acknowledges the possibility that future research will reveal that threatened classification is appropriate.

### NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

## Plate 61. ELAPIDAE

### 1. CHINESE COBRA *Naja atra*, p. 316.

TL 1,650mm Body moderate; head large; hood short.

(1a) **Body** Dorsum black, grey or brown, sometimes with narrow white cross-bars, split into double or quadruple bands.

(1b) **Hood** Mark consists of a mask, a monocle, a horseshoe or an O-shape.

### 2. MONOCLED COBRA *Naja kaouthia*, p. 316

TL 2.3m Body robust; head large; hood rounded.

(2a) **Body** Dorsum brown, greyish-brown, blackish-brown or pale yellow; some with darker bands.

(2b) **Hood** Mark consists of a light circle or mask-shape with a dark centre; 1–2 dark spots sometimes present in pale oval portion.

### 3. MANDALAY COBRA *Naja mandalayensis*, p. 316.

TL 1,400mm Body robust; head large; hood oval-elongate.

(3a) **Body** Dorsum mid-brown to dark brown with pale interstitial skin; light cross-bars.

(3b) **Hood** Mark consists of an indistinct spectacle, especially in juveniles, or hood is unpatterned.

### 4. INDO-CHINESE SPITTING COBRA *Naja siamensis*, p. 316.

TL 1,600mm Body robust; head large; hood oval.

(4a) **Body** Dorsum contrasting black and white pattern, to black or grey with white speckling; dark dorsum may be interrupted by light cross-bars.

(4b) **Hood** Marking absent, or U-, V- or H-shaped.

### 5. EQUITORIAL SPITTING COBRA *Naja sputatrix*, p. 316.

TL 1,500mm Body robust; head large; hood elongated; dorsum blackish-grey, silvery or brown; hood pattern chevron-shaped, or occasionally mask-, horseshoe- or spectacle-shaped, or unpatterned.

### 6. SUMATRAN COBRA *Naja sumatrana*, p. 317.

TL 1,500mm Body robust; head large; hood rounded in adults, more elongated in juveniles; dorsum bluish-black.

(6a) **Adult hood** Unpatterned dark brown or bluish-black; or with narrow pale cross-bars.

(6b) **Juvenile hood** Dark brown or bluish-black, unbanded or with 12 narrow pale cross-bars.

### 7. KING COBRA *Ophiophagus hannah*, p. 317.

TL 5.85m Body robust in adults, slender in juveniles; head large; hood elongated; juveniles with 27–84 yellow bands.

(7a) **Adult** From a population showing bands.

(7b) **Adult** From a population nearly unpatterned.

(7c) **Hatchling head** Forehead unpatterned.

(7d) **Juvenile head** Forehead with distinct pale bands.

### 8. KELLOG'S CORAL SNAKE *Sinomicrurus kelloggi*, p. 317.

TL 800mm Body slender; head short and rounded; dorsum reddish-brown with 17 dark cross-bars on body; forehead black with pale crescentic mark on snout; chevron at back of head.

### 9. MACCLELLAND'S CORAL SNAKE *Sinomicrurus maclellandi*, p. 317.

TL 840mm Body slender, cylindrical; head short and rounded; dorsum reddish-brown with 23–40 yellow or pale brown-edged black stripes; head black with cream or yellow band behind eyes.





## Plate 62. ELAPIDAE

### 1. HORNED SEA SNAKE *Acalyptophis peronii*, p. 318.

TL 1,250mm Body robust; head small, shields symmetrical, some with spines on posterior edges; dorsals keeled.

(1a) **Body** Dorsum light brown with dark bands encircling body, widest on vertebral region.

(1b) **Head** Forehead pale brown.

### 2. BEADED SEA SNAKE *Aipysurus eydouxii*, p. 318.

TL 1,500mm Body slender; head shields symmetrical, some with spines on posterior edges; dorsals smooth.

(2a) **Body** Dorsum brownish-olive with 44–55 tan or yellowish-cream bands, which may be broken up on vertebral region.

(2b) **Head** Forehead dark brown or olive.

### 3. STOKES'S SEA SNAKE *Astrotia stokesii*, p. 318.

TL 1,800mm Body short, robust; head enlarged; dorsals imbricate and keeled; dorsum yellowish-grey or pale brown with 24–37 black annuli on body; head black, dark olivaceous or yellow.

### 4. BEAKED SEA SNAKE *Enhydrina schistosa*, p. 318.

TL 1,580mm Body robust; head narrow; dorsals keeled.

(3a) **Body** Dorsum greyish-olive or silvery-grey with indistinct darker markings forming 40–60 transverse dark bands.

(3b) **Head** Rostral scale extends ventrally to form 'beak'; forehead dark.

### 5. AAGAARD'S SEA SNAKE *Hydrophis aagaardi*, p. 318.

TL 1,030mm Body moderately robust; head elongated; dorsals keeled, tuberculate; dorsum greyish-yellow or greenish-grey with 48–76 dark olive or black bands.

### 6. BLACK-HEADED SEA SNAKE *Hydrophis atriceps*, p. 319.

TL 1,200mm Body robust posteriorly; head very small; slender neck and forebody; dorsals with central keel; dorsum dark olive to black with yellow spots on sides, sometimes connected to form 50–75 cross-bars; posteriorly grey; yellow spot between nostril and eye or behind eye.

### 7. CAPTAIN BELCHER'S SEA SNAKE *Hydrophis belcheri*, p. 319.

TL 932mm Body robust to moderate; dorsals imbricate and hexagonal or rounded, keeled; dorsum olive-green with 48–64 dark bands, broad dorsally and narrow on flanks; head black flecked with olive.

### 8. RAJAH BROOK'S SEA SNAKE *Hydrophis brookii*, p. 319.

TL 1,035mm Body robust; head small; dorsals keeled; dorsum blackish-grey with 60–80 dark grey cross-bars, twice broader than pale interspaces; head greyish-black with curved yellow mark across snout.

### 9. BLUE-GREY SEA SNAKE *Hydrophis caeruleus*, p. 319.

TL 1,090mm Body moderately robust; head small; dorsals keeled.

(9a) **Body** Dorsum bluish-white or bluish-grey with 40–60 black bands, narrow on lower flanks.

(9b) **Head** Dark, upper jaw projecting.

### 10. ANNULATED SEA SNAKE *Hydrophis cyanocinctus*, p. 320.

TL 1,885mm Body elongated, moderately robust anteriorly, thickening posteriorly; dorsals strongly keeled.

(10a) **Body** Dorsum olive or yellow with numerous transverse bluish-black bands encircling body.

(10b) **Head** Small, yellowish-green.



## Plate 63. ELAPIDAE

### 1. BANDED SEA SNAKE *Hydrophis fasciatus*, p. 320.

TL 1,100mm Body slender anteriorly, thickening posteriorly; head small; dorsals juxtaposed or slightly imbricate and keeled; dorsum beige, dark olive to black with oval pale yellow spots on flanks, sometimes connected as cross-bars; posteriorly more grey in some individuals; rhomboidal dark spots along flanks may form annuli in juveniles.

### 2. NARROW-HEADED SEA SNAKE *Hydrophis gracilis*, p. 320.

TL 950mm Body slender anteriorly, thickening posteriorly; dorsals keeled.

(2a) **Body** Dorsum bluish-grey with 40–60 dark blue-black bands or lateral blotches.

(2b) **Head** Blue-black; upper jaw projecting.

### 3. KLOSS'S SEA SNAKE *Hydrophis klossi*, p. 320.

TL 1,190mm Body robust; head small; dorsals smooth or weakly keeled; dorsum blackish-grey to olivaceous-yellow with 50–75 dark cross-bars; bars broadest dorsally and broader than their interspaces; black vertebral stripe sometimes present; forehead black or olivaceous.

### 4. PERSIAN GULF SEA SNAKE *Hydrophis lapemoides*, p. 321.

TL 960mm Body robust; head moderate; dorsals weakly tuberculate or with short keel; dorsum grey with 29–52 rhombic black spots, wider on vertebral region and narrower on flanks; head dark dorsally with curved yellow or white mark from forehead to back.

### 5. LESSER DUSKY SEA SNAKE *Hydrophis melanosoma*, p. 321.

TL 1,390mm Body robust; head moderate; dorsals strongly keeled; dorsum blackish-grey with 50–70 wide white bands, subequal to their interspaces; head and body black with yellow subovoid marks; forehead with yellow speckles.

### 6. ORNATE SEA SNAKE *Hydrophis ornatus*, p. 321.

TL 1,150mm Body robust; head large; dorsals tuberculate or with short keel; dorsum greyish or olive to unpatterned cream, with 30–60 dark bars or rhomboidal spots separated by narrow interspaces on body.

### 7. BROAD-HEADED SEA SNAKE *Hydrophis pachycercos*, p. 322.

TL 1,110mm Body robust; head shields large and regular; dorsals keeled; dorsum light yellow with light brown bands; head black or dark grey; supralabials cream.

### 8. SIBAU RIVER SEA SNAKE *Hydrophis sibauensis*, p. 322.

TL 735mm Body slender; head narrower than body; dorsal scales with median keel; dorsum grey-brown, darkening posteriorly, with 49–58 yellow to light orange bands; forehead black with yellow spots and arrow-shaped marking.

### 9. SPIRAL SEA SNAKE *Hydrophis spiralis*, p. 322.

TL 2.75m Body moderately robust anteriorly, thickening posteriorly; head and neck slender; dorsals smooth or keeled; dorsum olive-yellow to olive-brown, with 35–50 dark bands narrower than interspaces; sometimes a black dorsal spot between bands; flanks yellowish-cream.



## Plate 64. ELAPIDAE

### 1. NARROW-NECKED SEA SNAKE *Hydrophis stricticollis*, p. 322.

TL 1,050mm Body slender; head small; scales feebly imbricate or juxtaposed, and keeled; dorsum greyish-olive with 45–65 dark bands in juveniles, broadest dorsally and narrow on flanks; head black or olive; snout and sides of head with small yellow patches.

### 2. GARLANDED SEA SNAKE *Hydrophis torquatus*, p. 322.

TL 895mm Body moderately robust; head moderate; dorsals keeled; dorsum greyish- or greenish-grey with over 50 dark brown bands on body and tail; forehead dark greyish-tan or dark olive, sometimes with horseshoe-shaped yellow mark.

### 3. SADDLE-BACKED SEA SNAKE *Kerilia jerdoni*, p. 323.

TL 1,000mm Body robust; head short; dorsals keeled and imbricate; midbody scale rows 21–23 (rarely 19); ventrals 200–278.

(3a) **Body** Dorsum yellowish-olive with black dorsal spots or rhomboidal marks forming bands.

(3b) **Head** Forehead dark grey; sometimes, a black band across neck.

### 4. ANNANDALE'S SEA SNAKE *Kolpophis annandalei*, p. 323.

TL 520mm Body robust; head small, narrower than widest part of body; fragmented head scales; dorsals keeled; dorsum greyish-purple with 35–46 dark bands, with bands broader than pale interspaces; head dark greyish-purple.

### 5. SHORT SEA SNAKE *Lapemis curtus*, p. 323.

TL 972mm Body robust; head broad and short; scales squarish or hexagonal, lowermost rows especially in males with a short keel; dorsum in juveniles brownish-grey to olive with 35–55 olive to dark grey bands that taper to a point on flanks; adults unpatterned olive to dark grey.

### 6. YELLOW-LIPPED SEA KRAIT *Laticauda colubrina*, p. 323.

TL 1,710mm Body robust, especially in adult females; dorsals smooth; midbody scale rows 21–25.

(6a) **Body** Dorsum blue-grey with 24–64 black bands.

(6b) **Head** Snout yellow; supralabials yellow.

### 7. LARGE-SCALED SEA KRAIT *Laticauda laticaudata*, p. 323.

TL 1,100mm Body robust in adult females; dorsals smooth; midbody scale rows 19; dorsum bright blue with 20–70 black bands; snout tan; supralabials dark brown or black.

### 8. YELLOW-BELLIED SEA SNAKE *Pelamis platura*, p. 324.

TL 1,000mm Body slender; head elongated, bill-like and slightly flattened; top half of dorsum black or dark brown, bottom half bright yellow or cream; venter light brown or yellow with black spots or bars; tail with diamond-shaped cream or yellow pattern.

### 9. GREY SEA SNAKE *Thalassophis viperina*, p. 324.

TL 925mm Body robust; head short, depressed; forehead scales entire; dorsals keeled; dorsum unicoloured grey, or with lighter mottling or 25–35 dark cross-bars or spots; forehead grey or black.





## Plate 65. HOMALOPSIDAE

### 1. KEEL-BELLIED WATER SNAKE *Bitia hydroides*, p. 324.

TL 800mm Body slender anteriorly, robust on posterior two-thirds; head narrow in juveniles, moderate in adults; dorsals smooth; dorsum greyish-blue, pale brown or greyish-yellow with 40–42 dark grey or black cross-bars on body; head dark brown or dark grey with 1–2 small dark brown spots on each scute.

### 2. YELLOW-BANDED MANGROVE SNAKE *Cantoria violacea*, p. 325.

TL 1,200mm Body slender; head indistinct from neck; dorsals smooth; dorsum dark blackish-grey or black with transverse yellow bars, narrower than interspaces; head white-spotted or with 2 yellow cross-bars.

### 3. DOG-FACED WATER SNAKE *Cerberus rynchops*, p. 325.

TL 1,270mm Body moderately robust; head long and distinct from neck; dorsals strongly keeled; dorsum dark grey or greyish-green with dark blotches; dark postocular stripe on neck.

### 4. BENNETT'S WATER SNAKE *Enhydrys bennetti*, p. 325.

TL 610mm Body moderate; head large; dorsals smooth.

(4a) **Body** Dorsum greyish-brown with irregular black or greyish-black cross-bars, sometimes forming zigzag pattern; white stripe adjacent to ventrals.

(4b) **Head** Greyish-brown; throat pale yellow.

### 5. BOCOURT'S WATER SNAKE *Enhydrys bocourti*, p. 325.

TL 1,100mm Body robust; head large; dorsals smooth; dorsum reddish-brown or dark brown, with transverse black-edged, reddish-brown bars, narrowing on flanks to meet ventrals; head reddish-brown.

### 6. CHINESE WATER SNAKE *Enhydrys chinensis*, p. 326.

TL 610mm Body moderate; head rounded; dorsals smooth; dorsum olive-brown or grey with irregular scattered black spots; sometimes, cream or yellow zigzag stripe on lower flanks.

### 7. MARQUIS DORIA'S WATER SNAKE *Enhydrys doriae*, p. 326.

TL 700mm Body robust; head small; forehead scales fragmented; dorsals smooth; dorsum reddish-brown to greyish-brown; labials blotched with grey or cream.

### 8. RAINBOW WATER SNAKE *Enhydrys enhydrys*, p. 326.

TL 810mm Body robust; head small; dorsals smooth; dorsum dark brown, greyish-brown or olive-green with 2 pale brown paravertebral stripes from upper surface of head to tail.

### 9. GYI'S WATER SNAKE *Enhydrys gyii*, p. 326.

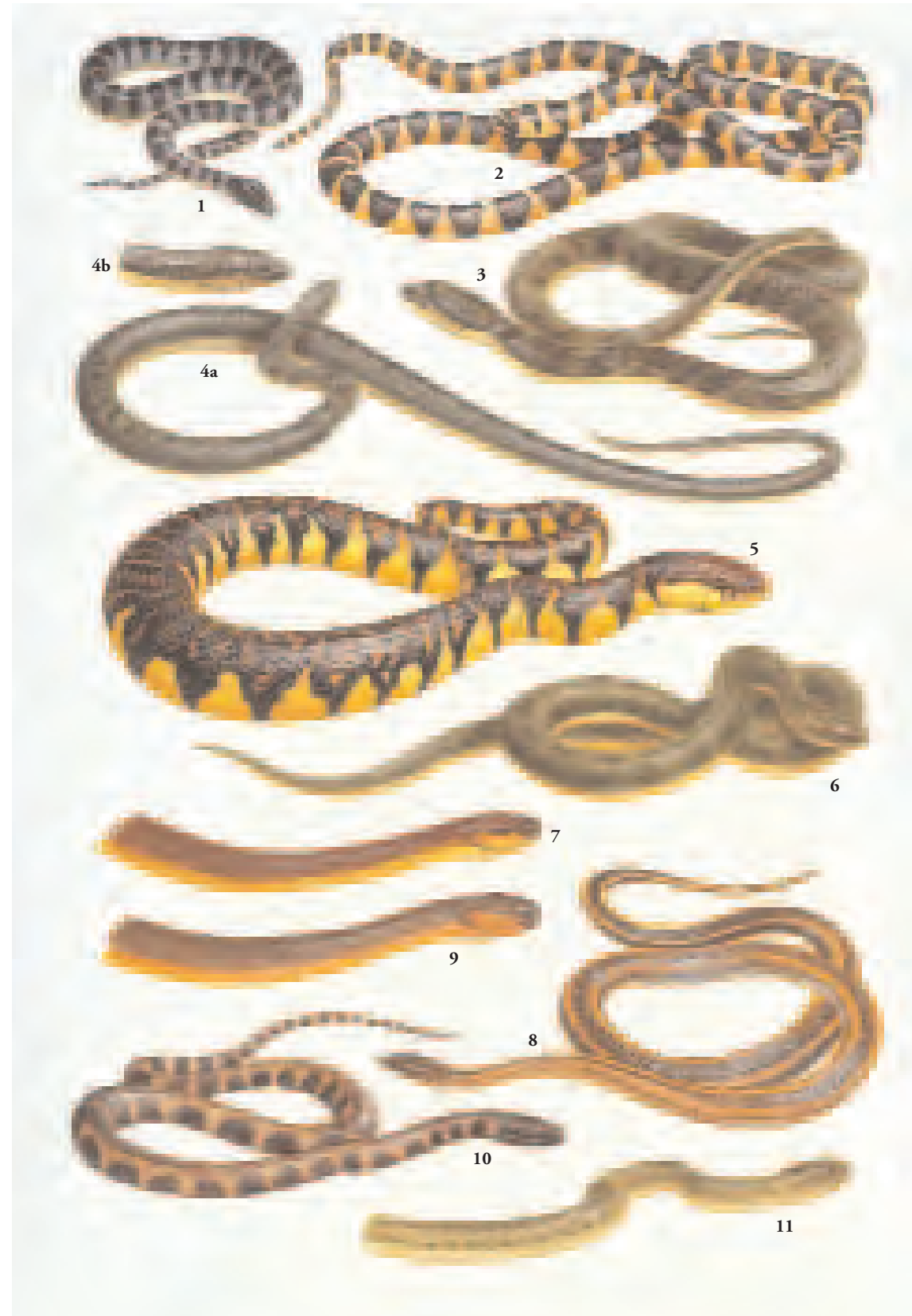
TL 766mm Body robust; head small; dorsals smooth; dorsum dark brown, except for reddish-brown lowest scale rows; anterior supralabials greyish-black; dark stripe from nape to angle of jaws.

### 10. BLACK-SPOTTED WATER SNAKE *Enhydrys innominata*, p. 327.

TL 175mm Body robust; head short; dorsals smooth; dorsum brownish-grey, sometimes with black spots in 3 longitudinal rows; flanks yellowish-white or tan with 38–39 vertical dark brown blotches; forehead with black spots.

### 11. JAGOR'S WATER SNAKE *Enhydrys jagorii*, p. 327.

TL 560mm Body robust; head short; dorsals smooth; dorsum greyish-brown with black ocellated spots arranged in linear series; supralabials yellowish-cream.



## Plate 66. HOMALOPSIDAE

### 1. GREY WATER SNAKE *Enhydris plumbea*, p. 328.

TL 480mm Body robust; head short; dorsals smooth; dorsum grey or greyish-olive; scales dark brown or black edged; supralabials cream or yellow.

### 2. SPOTTED WATER SNAKE *Enhydris punctata*, p. 328.

TL 730mm Body robust; head short; dorsals smooth; dorsum greyish-black to dark brown; yellow cross-bar on occipital region; sometimes, transverse rows of small yellow spots, of which 6–7 anterior rows form transverse bands.

### 3. INDO-CHINESE WATER SNAKE *Enhydris subtaeniata*, p. 328.

TL 870mm Body moderate; head indistinct from neck; dorsals smooth; dorsum mid-brown with black ventrolateral stripe covering scale rows 1–3; indistinct postocular stripe.

### 4. TENTACLED SNAKE *Erpeton tentaculatus*, p. 329.

TL 770mm Body slender; head small; dorsals strongly keeled.

(4a) **Body** Dorsum olive, grey or brown with 2 indistinct longitudinal dark paravertebral stripes; broad dark lateral stripe from snout, across orbit, to along flanks.

(4b) **Head** Long and scaly flexible rostral appendages.

### 5. CRAB-EATING MANGROVE SNAKE *Fordonia leucobalia*, p. 329.

TL 950mm Body robust; head short; dorsals smooth. Three colour morphs shown.

(5a) **Dark morph** Dark grey or brown.

(5b) **Yellow morph** Light yellow with dark spots.

(5c) **Orange morph** Orange with white spots.

### 6. GLOSSY MARSH SNAKE *Gerarda prevostiana*, p. 329.

TL 530mm Body slender; head small; dorsals smooth.

(6a) **Body** Dorsum grey, greyish-green or brown; sometimes, cream or yellow dorsolateral stripe.

(6b) **Head** Labials edged with dark grey or olive.

### 7. PUFF-FACED WATER SNAKE *Homalopsis buccata*, p. 329.

TL 1,400mm Body robust; head large and distinct from neck; dorsals keeled; dorsum greyish, dark brown or black with 19–51 narrow, black-edged yellow cross-bars.

### 8. CAMBODIAN PUFF-FACED WATER SNAKE *Homalopsis nigroventralis*, p. 330.

TL ca 1,400mm Body robust; head large and distinct from neck; dorsals keeled; interrupted cream ventrolateral stripe connects dorsal body bands; forehead black or grey; venter black with scattered cream or yellow spots in juveniles, yellowish-olive or olive-brown with cream spots in adults.

(8a) **Adult** Dorsum black or grey with yellowish-cream cross-bars.

(8b) **Juvenile** Dorsum black or grey with pale orange cross-bars; yellowish-tan bars or patch across head; X-shaped white mark on chin.



## Plate 67. NATRICIDAE

### 1. ANDREA'S KEELBACK *Amphiesma andreae*, p. 330.

TL 608mm Body slender; head distinct from neck; dorsals keeled; dorsum mid-brown; head and neck with pale dark-edged blotches, turning into pale black-edged bars on anterior body, indistinct at midbody.

### 2. MOUNTAIN KEELBACK *Amphiesma atemporale*, p. 330.

TL 500mm Body slender; head distinct from neck; dorsals keeled; dorsum reddish-brown to grey; scales edged with black; 2 pale dorsolateral stripes, sometimes broken up into spots; pale collar.

### 3. TWO-STRIPED KEELBACK *Amphiesma bitaeniatum*, p. 330.

TL 708mm Body moderate; head distinct from neck; dorsals keeled; dorsum dark brownish-grey or ochre-brown with beige-yellow dorsolateral stripe; forehead greyish-brown; dark brown postocular.

### 4. BOULENGER'S KEELBACK *Amphiesma boulengeri*, p. 331.

TL 877mm Body slender; head distinct from neck; dorsals weakly keeled, except smooth outermost rows; dorsum bluish-brown, greyish-black or brown with pair of white dorsal stripes on head that turn pinkish-brown on body; forehead brownish-grey with grey vermiculation; white postocular streak to nape.

### 5. KUATUN KEELBACK *Amphiesma craspedogaster*, p. 331.

TL 635mm Body slender; head distinct from neck; dorsals keeled; dorsum dark brown; rusty-red streak along flanks, with yellow spots; flanks with indistinct black spots; labials cream or yellow with black bars.

### 6. WHITE-FRONTED KEELBACK *Amphiesma flavifrons*, p. 331.

TL 750mm Body slender; head distinct from neck; dorsals keeled; dorsum greyish-brown or olive-grey with darker markings; series of white blotches on flanks to paravertebral region; white to yellowish-cream spot on snout; juveniles with paired white spots along midback.

### 7. GROUNDWATER'S KEELBACK *Amphiesma groundwateri*, p. 332.

TL 450mm Body slender; head distinct from neck; dorsals smooth anteriorly, weakly keeled posteriorly; dorsum black or dark brown with dorsolateral stripe comprising yellow spots; labials yellow with black edges; forehead dark; V-shaped yellow mark on neck.

### 8. GUNUNG INAS KEELBACK *Amphiesma inas*, p. 332.

TL 615mm Body slender; head distinct from neck; dorsals keeled; dorsum dark olive-brown with indistinct dorsolateral spots; flanks with yellow spots; forehead brown variegated with black.

### 9. KHASI HILLS KEELBACK *Amphiesma khasiense*, p. 332.

TL 600mm Body slender; head distinct from neck; dorsals keeled; dorsum reddish-brown with greyish-black vertebral stripe and dark reddish-brown lower flanks; forehead greyish-brown with pale brown marks.

### 10. WHITE-LIPPED KEELBACK *Amphiesma leucomystax*, p. 332.

TL 772mm Body slender in males, robust in females; head distinct from neck; first 2 dorsal scale rows smooth, rest keeled; dorsum brownish-grey; loose network on dorsum and flanks; indistinct pale beige dorsolateral stripe; head dark brown with irregular pale vermiculation and scattered beige dots; distinct white subocular stripe extends to neck.

### 11. GÜNTHER'S KEELBACK *Amphiesma modestum*, p. 333.

TL 600mm Body slender; head distinct from neck; dorsals keeled; dorsum mid-brown with indistinct small black and yellow spots on flanks that may form stripes; labials cream with dark margins or entirely dark; sometimes, series of yellow spots on flanks that may be fused.

### 12. MOUNT EMEI KEELBACK *Amphiesma optatum*, p. 333.

TL ca 650mm Body slender; head distinct from neck; dorsals weakly keeled; dorsum reddish-brown or bluish-black with 18–30 white cross-bars; flanks with vertical yellow bars; white preocular, postocular and subocular stripes.

### 13. STRIPED KEELBACK *Amphiesma parallelum*, p. 333.

TL 635mm Body robust; head distinct from neck; dorsals keeled except for outer row; dorsum reddish-brown, olive-brown or greyish-brown with dorsolateral stripes or series of spots; forehead brown; pale vertebral streak and black streak from eye to angle of mouth





## Plate 68. NATRICIDAE

### 1. PETERS'S KEELBACK *Amphiesma petersii*, p. 333.

TL 600mm Body slender; head distinct from neck; dorsals keeled; dorsum yellowish-pink or dark brown with rounded dark grey blotches; forehead dark olive with black vermiculation; labials yellow with black sutures.

### 2. RED MOUNTAIN KEELBACK *Amphiesma sanguineum*, p. 334.

TL 600mm Body slender; head distinct from neck; dorsals keeled; dorsum crimson with vertebral band comprising 4–5 rows of olive- and diamond-shaped black marks; flanks with 2 alternating rows of black spots; forehead dark olive; black-edged white postocular stripe; labials pale pink or cream with black sutures.

### 3. SARAWAK KEELBACK *Amphiesma saravacense*, p. 334.

TL 780mm Body slender; head distinct from neck; dorsals keeled; dorsum olive to reddish-brown, back with black squarish markings; supralabials yellow or cream.

### 4. SAUTER'S KEELBACK *Amphiesma sauteri*, p. 334.

TL 401mm Body slender; head distinct from neck; dorsals keeled; dorsum dark brown with small black and pink spots; indistinct reddish-brown streak on flanks; small pale spots on anterior flanks.

### 5. SIEBOLD'S KEELBACK *Amphiesma sieboldii*, p. 334.

TL 943mm Body slender; head distinct from neck; dorsals keeled; dorsum unpatterned olive-green or brown; sometimes, dorsolateral series of white spots; forehead brown; pale occipital spots and postparietal streak; supralabials bordered by dark stripe, forming nuchal crescent.

### 6. BUFF-STRIPED KEELBACK *Amphiesma stolatium*, p. 334.

TL 800mm Body robust; head distinct from neck; dorsals keeled; dorsum reddish-brown, olive-grey to greenish-grey; pale yellow or orange-yellow dorsolateral stripes on fifth to seventh scale rows.

### 7. VENNING'S KEELBACK *Amphiesma venningi*, p. 335.

TL 780mm Body slender; head distinct from neck; dorsals weakly keeled, outer scale rows smooth; dorsum olive-brown indistinctly chequered with black; anteriorly with dorsolateral ochre spots; head with lighter vermicular marks.

### 8. STRANGE-TAILED KEELBACK *Amphiesma xenura*, p. 335.

TL 660mm Body slender; head distinct from neck; dorsals keeled; dorsum olive-brown to nearly black with paired series of reddish-orange, pale brown, yellow or white spots on flanks; adjacent spots may be connected by faint black cross-lines; labials white with dark lines on sutures.

### 9. YELLOW-SPOTTED WATER SNAKE *Hydrablades periops*, p. 336.

TL 530mm Body slender; head distinct from neck; dorsals smooth; dorsum olive-brown with a pale yellow lateral stripe and a dark grey-black lateroventral one, or mostly unpatterned.



## Plate 69. NATRICIDAE

### 1. ORANGE-LIPPED KEELBACK *Macropisthodon flaviceps*, p. 336.

TL 850mm Body robust; head distinct from neck; dorsals keeled; dorsum greyish-black with faint light cross-bars, narrow at vertebral region and wide on flanks; forehead light brown, yellowish-brown or olive; rusty-orange supralabials; black-edged orange nuchal loop, especially in juveniles.

### 2. OLIVE KEELBACK *Macropisthodon plumbicolor*, p. 336.

TL 485mm Body robust; head distinct from neck; dorsals strongly keeled.

(2a) Adult Dorsum grass-green with a yellow tinge on lower flanks.

(2b) Juvenile Large V-shaped mark on neck, followed by similar, smaller one, with intervening areas of yellow or orange; black postocular stripe to angle of jaws; blue temporal region; black spots or cross-bars on dorsum.

### 3. BLUE-NECKED KEELBACK *Macropisthodon rhodomelas*, p. 336.

TL 750mm Body robust; head distinct from neck; dorsals keeled; dorsum reddish-brown; black vertebral stripe enters nape as inverted chevron; posteriorly, light blue.

### 4. ANDERSON'S STREAM SNAKE *Opisthotropis andersonii*, p. 337.

TL 500mm Body slender; head small, depressed, indistinct from neck; dorsals weakly keeled; dorsum greyish-black, green or olive-brown with indistinct fine black lines crossing scales; lowest row of dorsals bright yellow.

### 5. HAINANESE STREAM SNAKE *Opisthotropis balteata*, p. 337.

TL 1,050mm Body slender; head small, depressed, indistinct from neck; dorsals smooth; dorsum yellowish-orange with numerous paired black bands extending along flanks and meeting on venter; head mottled with black, with vertical yellow markings in front of and behind orbit, and one at angle of jaws.

### 6. DAO VAN TIEN'S STREAM SNAKE *Opisthotropis daovantieni*, p. 337.

TL 578mm Body slender; head small, depressed, indistinct from neck; dorsals smooth; dorsum pale brown or olive-grey; faint flank stripe located in dark dorsal coloration, not sharply separating dark dorsum from pale venter.

### 7. MAN-SON MOUNTAIN STREAM SNAKE *Opisthotropis lateralis*, p. 337.

TL 500mm Body moderate; head small, depressed, indistinct from neck; upper dorsals typically keeled, lower dorsals smooth; dorsum dark grey or greyish-brown; supralabials and infralabials yellow; faint dark lateral stripe on lower flanks sharply separates dark dorsum from pale venter.

### 8. SPOTTED MOUNTAIN STREAM SNAKE *Opisthotropis maculosus*, p. 337.

TL 520mm Body slender; head small, depressed, indistinct from neck; dorsals smooth; dorsum glossy black, scale with yellow spot; yellow spots larger on flank scales; forehead glossy black with scattered yellow flecks near sutures; labials yellow with black sutures.

### 9. CORRUGATED WATER SNAKE *Opisthotropis typica*, p. 338.

TL 502mm Body slender; head small, depressed, indistinct from neck; dorsals strongly keeled; dorsum unpatterned brownish- or blackish-grey.

### 10. PAINTED MOCK VIPER *Psammodynastes pictus*, p. 339.

TL 550mm Body slender; head flattened, distinct from neck; dorsals smooth, lacking apical pits; anal entire; dorsum brown or tan, sometimes black; transverse dark-edged light bands; dark streak along eye; venter cream with brown speckles.

### 11. MOCK VIPER *Psammodynastes pulverulentus*, p. 339.

TL 770mm Body slender; head flattened, distinct from neck; dorsals smooth, lacking apical pits; anal divided; dorsum reddish-brown to yellowish-grey, to nearly black, with small dark spots or streaks; sometimes, longitudinal stripe along middorsal region and 3 longitudinal stripes along flanks.



## Plate 70. NATRICIDAE

### 1. SAHUL KEELBACK *Rhabdophis chrysargoides*, p. 339.

TL 870mm Body moderate; head distinct from neck; dorsals keeled.

(1a) **Adult** Dorsum dark olive, black or blackish-brown.

(1b) **Juvenile** Pale orange-yellow vertebral stripe, scalloped edged anteriorly; white spot on sides of black head and occiput; white band across frontal, supraoculars and preoculars; supralabials yellow or pinkish-white, sutures black.

### 2. SPECKLE-BELLIED KEELBACK *Rhabdophis chrysargos*, p. 340.

TL 980mm Body moderate; head distinct from neck; dorsals keeled; dorsum olive-grey or olive-brown; supralabials yellow or cream with darker smudges; cream, reddish-brown or orange chevron on neck; rest of back with yellow and brown oblong marks, within darker bands.

### 3. RED-BELLIED KEELBACK *Rhabdophis conspicillatus*, p. 340.

TL 550mm Body moderate; head distinct from neck; dorsals keeled, except outer rows; dorsum brown to reddish-brown; sides of head with cream postocular stripe that curves downwards; supralabials cream; nape and neck with 2 narrow cream collars.

### 4. HIMALAYAN KEELBACK *Rhabdophis himalayanus*, p. 340.

TL 1,250mm Body moderate; head distinct from neck; dorsals keeled; dorsum olive, olive-brown or dark brown; 2 dorsolateral rows of widely separated, orange-yellow spots; anterior body chequered with vermilion spots; neck with bright yellow collar, edged with black at back; labials cream or yellow edged with black; black subocular stripe.

### 5. LEONARD'S KEELBACK *Rhabdophis leonardi*, p. 340.

TL 1,060mm Body moderate; head distinct from neck; dorsals keeled, except 2–3 lower rows; dorsum olive-brown; head olive-brown turning greyish-cream near labials; narrow black subocular stripe; sometimes, narrow reddish-orange cross-bar on nuchal region; indistinct dark vertebral stripe, darkening posteriorly.

### 6. GUNUNG MURUD KEELBACK *Rhabdophis murudensis*, p. 340.

TL 873mm Body moderate; head distinct from neck; dorsals keeled, except outer rows; dorsum brownish-grey with indistinct dark cross-bars; row of light spots on edges of cross-bars; supralabials yellow, bright red or brown.

### 7. BLACK-BANDED KEELBACK *Rhabdophis nigrocinctus*, p. 341.

TL 950mm Body moderate; head distinct from neck; dorsals keeled.

(7a) **Adult** Dorsum olive-green turning brown posteriorly, with indistinct, narrow black cross-bars; 2 oblique black stripes on flanks; forehead copper-brown, lighter on sides; oblique black subocular and postocular stripes, another on nape.

(7b) **Juvenile** Forehead paler than that of adult; yellowish-cream nuchal bar.

### 8. COLLARED KEELBACK *Rhabdophis nuchalis*, p. 341.

TL 620mm Body moderate; head distinct from neck; dorsals keeled, except outer row; dorsum light brown chequered with pale reddish-brown spots; forehead brown speckled with red; alternate rows of body scales red and brown; interstitial skin bluish-black; juvenile with reddish-yellow collar, posteriorly with reddish tinge.

### 9. RED-NECKED KEELBACK *Rhabdophis subminiatus*, p. 341.

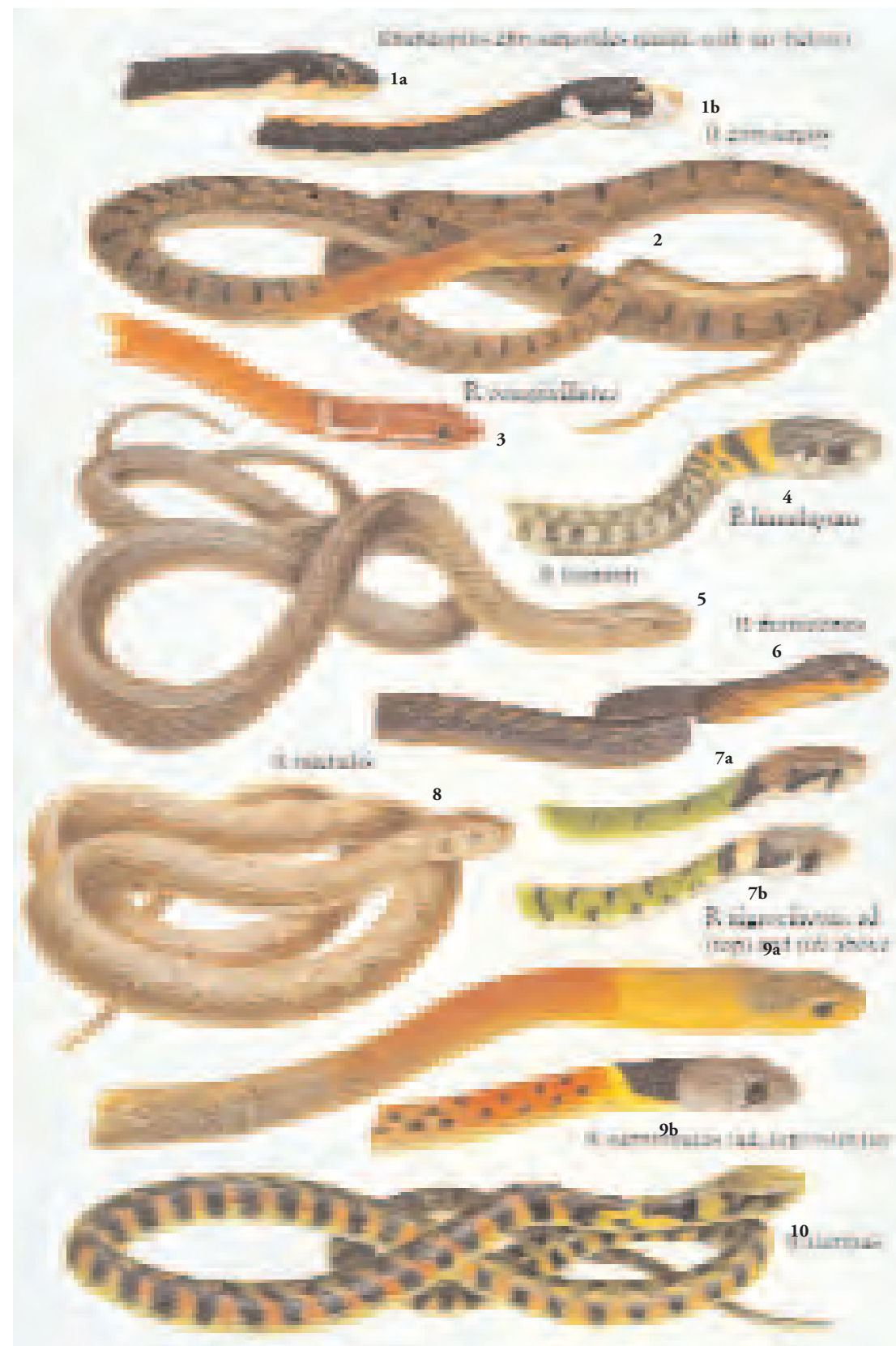
TL 1,300mm Body moderate; head distinct from neck; dorsals keeled, except outer rows.

(9a) **Adult** Dorsum olive-brown or green, unpatterned or with black and yellow reticulation; forehead yellowish-olive; nape with yellow and red band; indistinct oblique dark subocular bar.

(9b) **Juvenile** Dorsum with oval black spots; forehead grey; black nuchal patch; oblique dark subocular bar.

### 10. JAPANESE KEELBACK *Rhabdophis tigrinus*, p. 341.

TL 1,013mm Body robust; head distinct from neck; dorsals keeled; dorsum greenish-olive anteriorly, orange-red elsewhere, with series of large rectangular black spots; curved black spot on sides of neck.





## Plate 71. NATRICIDAE

### 1. CHINESE SPOTTED KEELBACK WATER SNAKE *Sinonatrix aequifasciata*, p. 342.

TL 1,420mm Single supralabial enters eye; ventrals 142–153; subcaudals 67–76; males with tubercles on chin shields and on Infralabial I; dorsum with 16–21 bands encircling body and 7–12 on tail.

### 2. RINGED KEELBACK WATER SNAKE *Sinonatrix annularis*, p. 342.

TL 941mm Ventrals 145–163; subcaudals 58–69; body with dark cross-bars, numbering 34–46 on body and 16–27 on tail; venter red between dark cross-bars.

(2a) Adult Dorsal pattern obscure.

(2b) Juvenile Dorsal pattern distinct.

### 3. CHINESE KEELBACK WATER SNAKE *Sinonatrix percarinata*, p. 342.

TL 1,100mm Head large, distinct from neck; ventrals 133–157; subcaudals 68–85; dorsum and forehead olive-grey with light-edged black bars on flanks; rest of head yellowish-cream.

(3a) Adult Dorsal pattern obscure.

(3b) Juvenile Dorsal pattern distinct.

### 4. YUNNAN KEELBACK WATER SNAKE *Sinonatrix yunnanensis*, p. 342.

TL 498mm Ventrals 156–165; subcaudals 61–83; dorsum brown or brownish-black with transverse black lines that form X-pattern on flanks.

### 5. YELLOW-SPOTTED KEELBACK WATER SNAKE *Xenochrophis flavipunctatus*, p. 342.

TL 974mm Keels become more distinct posteriorly and lack apical pits; ventrals 122–143; subcaudals 70–91; dorsum olivaceous or greenish-grey with black spots, turning into reticulated pattern posteriorly.

(5a) Yellow phase.

(5b) Red phase.

### 6. MALAYAN SPOTTED KEELBACK WATER SNAKE *Xenochrophis maculatus*, p. 343.

TL 1,000mm. Two anterior temporals; ventrals 140–156; subcaudals 95–117; dorsum brownish-orange with 4 longitudinal series of small dark squarish marks; sometimes, paired row of yellow spots.

### 7. JAVAN KEELBACK WATER SNAKE *Xenochrophis melanostomus*, p. 343.

TL 975mm Tail relatively short in females; ventrals 128–142; subcaudals 66–83; 2 colour morphs: with elongated blotches on dorsum or with broad longitudinal dark stripes on dorsum.

(7a) Adult Dorsum brown.

(7b) Juvenile Dorsum orange.

### 8. CHEQUERED KEELBACK WATER SNAKE *Xenochrophis piscator*, p. 343.

TL 1,020mm Dorsal scales strongly keeled; ventrals 132–151; subcaudals 68–99; dorsum olive-brown with black spots arranged in 5–6 rows; black stripe from eye to upper lip and from postoculars to edge of mouth.

### 9. ST JOHN'S KEELBACK WATER SNAKE *Xenochrophis sanctijohannis*, p. 343.

TL 710mm Supralabial IV touches eye; dorsal scales feebly keeled or nearly smooth; ventrals 139–154; subcaudals 84–94; dorsum pale olive, uniform or with indistinct dark spots, sometimes with double series of cream spots along body.

### 10. RED-SIDED KEELBACK WATER SNAKE *Xenochrophis trianguligerus*, p. 343.

TL 1,350mm. Head large, distinct from neck; ventrals 134–145; subcaudals 86–97; dorsum blackish-brown with orange-red triangles on nape and front of body; triangle-shaped dark marks on forebody.

### 11. STRIPED KEELBACK WATER SNAKE *Xenochrophis vittatus*, p. 344.

TL 700mm. Supralabials IV–VI contact eye; ventrals 140–151; subcaudals 53–84; dorsum mid-brown with 3 black stripes; head with dense mottling or dark areas.





## Plate 72. PAREATIDAE & PSEUDOXENODONTIDAE

### 1. BLUNT-HEADED SLUG SNAKE *Aplopeltura boa*, p. 344.

TL 850mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals smooth; dorsum brown to greyish-brown with dark-edged saddle; flanks sometimes with large cream spots; forehead dark brown; cream subocular patch with dark subtriangular area.

### 2. SMOOTH SLUG SNAKE *Asthenodipsas laevis*, p. 344.

TL 600mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals smooth; dorsum brown with dark vertical bars, extending to venter; forehead darker than dorsum, lacking lines.

### 3. MALAYAN SLUG SNAKE *Asthenodipsas malaccanus*, p. 344.

TL 450mm Body robust, laterally compressed; head short, rounded, distinct from neck; dorsals with weak keels; dorsum pale brown, mid-brown to nearly black with brownish-grey cross-bars, sometimes edged with white; forehead darker than dorsum; dark brown or black band on neck and forebody.

### 4. MOUNTAIN SLUG-EATING SNAKE *Asthenodipsas vertebralis*, p. 345.

TL 771mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals smooth; dorsum greyish-brown with dark brown spots and sometimes indistinct dark cross-bars; interrupted yellow vertebral stripe occasionally present.

### 5. KEELED SLUG-EATING SNAKE *Pareas carinatus*, p. 345.

TL 600mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals weakly keeled on 2 median rows; dorsum olive-brown, yellow or reddish-brown with indistinct transverse black bars on anterior body; dark streak along eye.

### 6. HAMPTON'S SLUG-EATING SNAKE *Pareas hamptoni*, p. 345.

TL 705mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals smooth; dorsum light brown with vertical black cross-bars; forehead with dense black spots.

### 7. SPOTTED SLUG-EATING SNAKE *Pareas macularius*, p. 345.

TL 450mm Body slender, laterally compressed; head short, rounded, distinct from neck; median dorsals keeled; dorsum grey with dark spots or black cross-bars; labials pale; pale nuchal collar may be present.

### 8. WHITE-SPOTTED SLUG-EATING SNAKE *Pareas margaritophorus*, p. 345.

TL 450mm Body slender, not laterally compressed; head short, rounded, distinct from neck; dorsals smooth; dorsum grey with black cross-bars bordered with white; labials cream with black mottling; white or yellow nuchal collar may be present.

### 9. MONTANE SLUG-EATING SNAKE *Pareas monticola*, p. 346.

TL 610mm Body slender, laterally compressed; head short, rounded, distinct from neck; dorsals weakly keeled; dorsum mid-brown with blackish-brown bars on flanks; black postocular stripe to nape; black postocular streak; forehead brown with dense black spots.

### 10. BAMBOO FALSE COBRA *Pseudoxenodon bambusicola*, p. 346.

TL 530mm Body robust; head distinct from neck; dorsals keeled; dorsum light brownish-grey or yellow-brown with 15–24 distinct black cross-bars; black or dark brown chevron on forehead.

### 11. KARL SCHMIDT'S FALSE COBRA *Pseudoxenodon karlschmidtii*, p. 347.

TL 1,730mm Body robust; head distinct from neck; dorsals keeled; dorsum greyish-black to dark brown; dark chevron in juveniles; vertebral region with 24 grey or yellow spots; anterior flanks with rows of spots composed of black-bordered scales.

### 12. LARGE-EYED FALSE COBRA *Pseudoxenodon macrops*, p. 347.

TL 1,400mm Body robust; head distinct from neck; dorsals keeled, except lower rows; dorsum brownish-grey, red or olivaceous; series of yellow, reddish-brown or orange cross-bars or spots; nape with dark chevron; throat pale yellow.





## Plate 73. TYPHLOPIDAE

### 1. WHITE-HEADED BLIND SNAKE *Ramphotyphlops albiceps*, p. 348.

TL 302mm Body slender; head indistinct from neck, spatulate; midbody scale rows 20; dorsum dark brown; forehead red or buff; chin, gular region and tail cream.

### 2. BRAHMINY BLIND SNAKE *Ramphotyphlops braminus*, p. 348.

TL 180mm Body moderate; head indistinct from neck; midbody scale rows 20; dorsum black or brown; snout and tip of tail paler.

### 3. LINED BLIND SNAKE *Ramphotyphlops lineatus*, p. 348.

TL 480mm Body moderate; head indistinct from neck; midbody scale rows 22–24; dorsum cream, pinkish-brown or yellow with 10 longitudinal brown stripes from head to tail-tip.

### 4. BLACK BLIND SNAKE *Typhlops ater*, p. 348.

TL 166mm Body slender; head indistinct from neck; midbody scale rows 18; dorsum black or dark brown; chin and anal region cream.

### 5. DIARD'S BLIND SNAKE *Typhlops diardii*, p. 349.

TL 430mm Body moderate; head indistinct from neck; midbody scale rows 24–26 (rarely 28).

(5a) **Dorsum** Dark brown, each scale with indistinct transverse light streak; flanks light brown; gradual transition between dark dorsum and pale venter.

(5b) **Caudal spine** Sharp.

### 6. JERDON'S BLIND SNAKE *Typhlops jerdoni*, p. 349.

TL 280mm Body moderate; head indistinct from neck; midbody scale rows 20–22; dorsum dark brown to nearly black; snout and anal region cream.

### 7. MÜLLER'S BLIND SNAKE *Typhlops muelleri*, p. 350.

TL 540mm Body moderate; head indistinct from neck; midbody scale rows 24–26 (rarely 28–30); dorsum dark brown, purple or black; clear line of demarcation between dark dorsum and yellow, cream or gold venter.





## Plate 74. XENODERMATIDAE, XENOPELTIDAE & XENOPHIDIIDAE

### 1. BLACK BURROWING SNAKE *Achalinus ater*, p. 351.

TL 401mm Body slender, cylindrical; head indistinct from neck; dorsals keeled; midbody scale rows 23; subcaudals 56–63; dorsum iridescent black or dark brown; sides of ventrals paler.

### 2. RUFOUS BURROWING SNAKE *Achalinus rufescens*, p. 351.

TL 450mm Body slender, cylindrical; head indistinct from neck; dorsals strongly keeled; midbody scale rows 23 or 25; subcaudals 54–82; dorsum reddish-brown or greyish-brown; head and body with iridescent sheen.

### 3. GREY BURROWING SNAKE *Achalinus spinalis*, p. 351.

TL 412mm Body slender, cylindrical; head indistinct from neck; dorsals strongly keeled; midbody scale rows 21 or 23; subcaudals 39–62; dorsum iridescent walnut-brown, rufous medially; dark vertebral line extends to tail-tip; nuchals with black central spot.

### 4. KLOSS'S ROUGH WATER SNAKE *Fimbrios klossi*, p. 351.

TL 395mm Body slender, cylindrical; head long; dorsals keeled.

(4a) **Body** Dorsum uniform dark grey, olivaceous or purple brown, lacking pale blotches and stripes.

(4b) **Head** Pale grey; loreal large; preocular absent.

### 5. STOLICZKA'S STREAM SNAKE *Stoliczka borneensis*, p. 352.

TL 750mm Body slender, laterally compressed; sharp ridge on vertebral region; dorsals strongly keeled.

(5a) **Body** Dorsum dark bluish-black or dark greyish-brown with short transverse dark bands, as broad as or broader than interspaces.

(5b) **Head** Large; nostrils large and flaring; eye small and beady; forehead with 2 rows of small scales in front of eyes, separating prefrontals from frontal.

### 6. ROUGH-BACKED LITTER SNAKE *Xenodermus javanicus*, p. 352.

TL 650mm Body slender, compressed; head large, distinct from neck; 3 rows of large keeled scales on dorsum; exposed skin between scales.

(6a) **Body** Dorsum unpatterned grey; ridges on scales cream.

(6b) **Head** Snout pale grey; nasal scales enlarged; nostrils flaring and pointed forwards.

### 7. HAINAN SUNBEAM SNAKE *Xenopeltis hainanensis*, p. 352.

TL 628mm Body robust, cylindrical; head slightly distinct from neck; single postocular; dorsum iridescent bluish-brown; 2 series of white spots in longitudinal series.

### 8. SUNBEAM SNAKE *Xenopeltis unicolor*, p. 353.

TL 1,140mm Body robust, cylindrical; head slightly distinct from neck; postoculars 2; supralabials 8; dorsals smooth.

(8a) **Body** Dorsum iridescent brown, each scale light-edged.

(8b) **Head** Snout rounded and depressed; large interparietal in middle of 4 parietals.

(8c) **Juvenile** Yellow, white or cream collar.

### 9. SCHÄFER'S SPINY-JAWED SNAKE *Xenophidion schaeferi*, p. 353.

TL 263mm Body slender, moderately compressed; head indistinct from neck; dorsals keeled; dorsum dark brown, iridescent, with undulating greyish-whitish stripe on paravertebral region, from neck to tail-tip.

